A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY

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I declare that the thesis entitled "**A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY**" has been prepared by me under the guidance of **Dr. Prabhdeep Singh Nain**, Professor, Department of General Surgery, Dayanand Medical College and Hospital, Ludhiana. No part of this thesis has formed the basis for the award of any degree previously.

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Dedicated

to

my family

&

Teachers

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ABBREVIATIONS

&	AND
BS	Bariatric surgery
BMI	body mass index
CVD	Cardiovascular disease
CRP	C reactive protein
DALYs	Disability adjusted life years
DI	dietary intake
%EWL	percentage of excess weight loss
GLP-1	glucagon like peptide-1
GIQLI	Gastro-intestinal Quality of Life Index
HRQOL	health-related quality of life
LDL	low density lipids
LSG	Laparoscopic sleeve gastrectomy
LMGB	Laparoscopic mini gastric bypass
LRYGB	Laparoscopic Roux-en-Y Gastric Bypass
LAGB	Laparoscopic Adjustable Gastric Banding
MCV	mean corpuscular volume
MP	Metabolic parameters
NP	nutritional parameters
OAGB MGB	one anastomosis gastric bypass-mini gastric bypass
PTH	parathyroid hormone
PYY	peptide YY

T2DM	Type 2 Diabetes mellitis
TFCA	true fractional calcium absorption
WC	waist circumference

ABSTRACT

Introduction: Obesity is a major worldwide problem in public health. Bariatric procedures have been shown to be more effective in the management of morbid obesity as compared to medical treatments in term of weight loss and sustainability. The two most commonly performed procedures are sleeve gastrectomy and gastric mini bypass. It has been shown that not only it causes rapid weight loss but also has effect on nutritional status of patient. Nutritional parameters include macronutrients like Total protein, Albumin and micronutrients such as Serum ferritin, Folic acid, Vitamin B12.

Aim of Study: To assess prevalence of nutritional deficiencies and compare differences in nutritional complications among mini gastric bypass and sleeve gastrectomy.

Materials & Methods: This prospective study was conducted at Dayanand Medical College and Hospital, Ludhiana for patients undergoing bariatric surgery for 1 ½ year.

Result: Weight loss was observed to be more after MGB than SG group.The Mean values in two studied group i.e MGB and SG respectively at 0,3 and 6 months were as follows total protein levels loss(7.32 g/dL to 6.91 g/dL& 6.38 g/dL and 7.39 g/dL to 7.23 g/dL& 7.11 g/dL), albumin loss(4 to 3.67 g/dL&3.52 g/dL and 4.15 g/dL to 4.18g/dL & 3.97 g/dL), ferritin levels loss(39.61 ng/mL to 34.73 ng/mL & 28.69 ng/mL and 52.26 ng/mL to 50.86 ng/mL& 49.37 ng/mL), folic acid loss(8.27 n ng/mL to 6.88 ng/mL & 6.58 ng/mL and 9.80 ng/mL to 9.57 ng/mL& 9.33 ng/mL) vitamin B12 loss(275.81pg/mL to 241pg/mL& 216.65pg/mL and 271.54pg/mL to 261.56pg/mL& 242.72pg/mL) andcalciumlevels loss(8.73mg/dL to 8.07mg/dL & 7.83mg/dL and 8.71mg/dL to 8.57mg/dL & 8.36mg/dL).This shows that there was a significant difference of nutritional parameters duringMini gastric bypass and Sleeve gastrectomy.

Conclusion: We observed that nutritional parameters like Total protein, Albumin, Ferritin, Folic acid, Vit B12, Calcium levels were reduced during the both bariatric procedures but it was evident more in mini gastric bypass than sleeve gastrectomy. Thus, nutritional surveillance and supplementation is an essential component of the management of bariatric patients.

Keywords: Sleeve Gastrectomy, Mini Gastric Bypass, Morbid Obesity, Nutritional deficiency.

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INTRODUCTION

"Surgeons must be very careful when they take the knife! Underneath their fine incisions stirs the Culprit - Life!"

Emily Dickinson

Obesity is a chronic disease that has already reached pandemic proportions and is becoming one of the leading causes of death and disability worldwide. In whole world population, obesity is getting more prevalent and it is now replacing conditions like undernutrition and various infectious diseases. Obesity has become the most significant contributor to ill health. It is found to be associated with various systemic conditions like Diabetes mellitus Type-2, coronary heart disease, carcinomas, depression, sleep-breathing disorders etc.

Obesity is defined as excess body weight in proportion to the height of a person. But this simple definition belies an etiologically complex phenotype, which is primarily associated with excess adipose tissue deposition. Thus, it is not only defined in terms of body size, but as a metabolic disorder.

To manage this metabolic disorder, it has become essential to measure the level of obesity of an individual. One of the most recognized method for determining health risk related to weight is to calculate the body mass index (BMI) of an individual. Body mass index (BMI) is the parameter used to define obesity in terms of Kg/m^2.[1,2] Obesity has been graded according to BMI of an individual by World Health Organization (WHO). WHO has classified patients according to their BMI into overweight (BMI ≥ 25 kg/m^2), and obese (BMI ≥ 30 kg/m^2) for both the gender. But this classification does not take into account the detrimental effects of intra-abdominal fat, morbidity and mortality associated with degrees of overweight and obesity. There are various etiological factors responsible for this global epidemic of obesity like genetic susceptibility, increased availability of high-energy foods and decreased requirement for physical activity in modern life style.

Keeping in mind the increasing prevalence rate of patients suffering with obesity, it should not only be considered as a cosmetic problem affecting certain individuals, but as an epidemic that is threatening a large part of population over global well-being.[1]

In 2014, more than 1.9 billion adults (18 years and older) in world were found to be overweight. Out of these, over 600 million adults were obese and 42 million children under 5yrs of age were overweight or obese.[2] It has been further anticipated that if recent trends will continue further, around 60% of the world's population, i.e. 3.3 billion people, could be overweight (2.2 billion) or obese (1.1 billion) by 2030. Obesity can cause increase in mortality rate. A surveillance report of 2010 revealed that overweight and obesity has caused around 3.4 million deaths, 4% decrease in life span, and 4% increase in disability-adjusted life years (DALYs).[2]

The BMI measurement does not account for the exact distribution of fat in the body of an individual relative to the body size. This limitation can be compensated by measuring the Waist circumference (WC), which takes regional fat into consideration. It has been observed that WC has an association with the prevalence of cardiovascular disease (CVD) in patients suffering with obesity. This indicates the potential utility of using WC in addition to BMI in clinical practice for determining the obesity risk assessment. This combination has increased the clinician's ability to identify the individuals at high risk for diseases that correlate with excess adiposity.

It has been observed that multiple hormones are involved in the regulation and pathophysiology of obesity, including gut-related hormones, adipokines and others. Ghrelin is a circulating peptide hormone derived from the stomach. It is the known as peripherally acting orexigenic hormone that is responsible for stimulating appetite. All other gut-derived hormones serve as anorectic agents. They are responsible for limiting food intake to achieve optimal digestion and absorption, thus avoiding the

consequences of overfeeding, such as hyperinsulinemia and insulin resistance. Several hormones, collectively referred to as adipokines, are produced by the adipocytes.[3]

It has been observed that a comprehensive, sustainable, and proactive strategy is required to deal with the challenges posed by the obesity epidemic. Body mass index (BMI) and anthropometric measures like waist circumference are thus proved to be the useful parameters in diagnosing obesity.

The treatment of obesity includes both surgical and non-surgical interventions, as recommended by National Institutes of Health (NIH).[4] The non-surgical approaches include low- and very low- calorie diets, behavioral modification, exercise, and the use of pharmacological agents. These methods for weight loss are limited as they fail to create a long term reduction in weight. Weight loss induced by surgery has proven to be highly efficacious in treating obesity and its co-morbidities.

Although the parameters like BMI and WC are very useful in diagnosing obesity, but they have important limitations when applied to individuals, as indications for surgery for obesity and weight-related diseases. Before planning any surgical intervention, it is important to consider the metabolic co-morbidities, like type 2 diabetes mellitus (T2DM), physical symptoms, psychological/psychiatric symptoms, and the limitations of functional status.

Recently, the population has trended towards the use of bariatric surgeries due to the higher rate of success and long-term weight maintenance. The Bariatric surgery (BS) is currently the most effective treatment modality for obesity and its associated metabolic complications. The main benefits of this intervention include prolonged weight loss, improvement of associated comorbidities, and quality of life.[5] The weight loss surgeries are reserved for patients with morbid obesity. The eligible patients are those with a BMI of 40 kg/m^2 or more, in whom diet and medical therapy have failed or patients with a BMI of 35 kg/m^2 or more, with co-morbid conditions.

Surgical weight loss can be achieved by restrictive, malabsorptive or combination procedures.[6] Most novel gastric surgeries are the Laparoscopic mini gastric bypass (LMGB) and sleeve gastrectomy (LSG). Many obese subjects are suffering with already-existing nutritional deficiencies before undergoing bariatric procedures. A combination of the already prevaling nutritional deficiencies preoperatively, malabsorption and decreased intake following bariatric surgery, may render patients prone to severe micronutrient deficiencies. Iron, calcium, vitamin D, vitamin B12, and folate are the most common deficiencies observed after gastric bypass surgery leading to anemia. As a result, patients may develop weakness, fatigue, shortness of breath, and reduced cognitive performance. Thus, a multivitamin–mineral supplement is recommended for patients undergoing surgery for obesity.[7]

Although Laparoscopic sleeve gastrectomy (LSG) is considered mainly restrictive, but removal of 60–80% of the stomach may lead to deficiencies in gastric acid and intrinsic factors- necessary for effective absorption of iron, B_{12}, and folate.[8] It is therefore plausible that LSG encompasses malabsorptive characteristics.

A Laparoscopic mini gastric bypass (LMGB) is a less invasive alternative to standard gastric bypass. This procedure is performed laparoscopically by a surgeon. The technique involves giving several small incisions using special instruments, guided by a tiny camera (called a laparoscope) and a television screen. The stomach is divided with a laparoscopic stapler. Thus, most of the part of stomach is no longer attached with the esophagus and will not receive food. The new stomach is much smaller and shaped like a small tube. The 2 to 7 feet of intestine is bypassed and surgeon attaches the remaining portion of intestine to the new stomach. Food now flows into small tube-like stomach, (bypassing around 2 to 7 feet of intestine) and resumes the normal digestive process in the remaining part of intestine.

The screening and correction of micronutrient deficiencies play a crucial role pre-operatively, as these deficiencies may be more exacerbated following bariatric procedures, leading to devastating conditions. The patients are required to follow a multidisciplinary approach to accomplish the changes in their diet and life style post-operatively. The patients need an individualized dietetic approach, both before and after surgery, and long-term support in order to establish a more appropriate eating pattern. The interdisciplinary team must ensure that the patient should understand the surgical procedure and the need for changes in eating habits and food choices. A strong social support is also necessary for the patients undergoing surgical interventions. While several studies[9-11] have described nutrient status pre- and post-bariatric surgery, but there is paucity of studies in the Indian literature that investigates the nutritional status before and after surgery in obese subjects.

Hence the present study was planned to assess and compare the preoperative and postoperative nutritional status between two types of surgical interventions i.e Mini gastric bypass and Sleeve gastrectomy.

AIMS AND OBJECTIVES

- To assess preoperative and postoperative nutritional status between min gastric bypass and sleeve gastrectomy at 3 months and 6 months.
- To compare preoperative and various postoperative nutritional status between min gastric bypass and sleeve gastrectomy.

REVIEW OF LITERATURE

Alvarez-Leite JI *et al* (2004) conducted a review titled "Nutrient deficiencies secondary to bariatric surgery." This review describes the literature published in the last few years concerning nutritional deficiencies after bariatric surgery as well as their etiology, incidence, treatment and prevention. Although bariatric surgery was first introduced in the 1950s, safe and successful surgical management has progressed over the last two decades and longer post-surgical follow-up data are now available. Most of the patients undergoing malabsorptive procedures will develop some nutritional deficiency, justifying mineral and multivitamin supplementation to all postoperatively. The nutrient deficiency is proportional to the length of absorptive area and to the percentage of weight loss. Low levels of iron, vitamin B_{12}, vitamin D and calcium are predominant after Roux-en-Y gastric bypass. The protein and fat-soluble vitamin deficiencies are mainly detected after biliopancreatic diversion. The thiamine deficiency is common in patients with frequent vomiting. As the incidence of these deficiencies progresses with time, the patients should be monitored frequently and regularly to prevent malnutrition.[12]

Lee WJ *et al* (2005) conducted a study titled "Laparoscopic Roux-en-Y Versus Mini-Gastric Bypass for the treatment of Morbid Obesity: A Prospective Randomized Controlled Clinical Trial." This prospective, randomized trial compared the safety and effectiveness of laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic mini-gastric bypass (MGB) in the treatment of morbid obesity. Eighty patients who met the NIH criteria were recruited and randomized to receive either LRYGBP (*n* = 40) or MGB (*n* = 40). The minimum postoperative follow-up was 2 years (mean, 31.3 months). Perioperative data were assessed. Late complication, excess weight loss, BMI, quality of life, and comorbidities were determined. Changes in quality of life were assessed using the Gastro-Intestinal Quality of Life Index (GIQLI). The results showed that

there was one conversion (2.5%) in the LRYGB group. Operation time was shorter in MGB group (205 versus 148, *P*< 0.05). There was no mortality in each group. The operative morbidity rate was higher in the LRYGB group (20% versus 7.5%, *P*< 0.05). The late complications rate was the same in the 2 groups (7.5%) with no reoperation. The percentage of excess weight loss was 58.7% and 60.0% at 1 and 2 years, respectively, in the LRYGB group, and 64.9% and 64.4% in the MGB group. The residual excess weight <50% at 2 years postoperatively was achieved in 75% of patients in the LRYGB group and 95% in the LMGB group (*P*< 0.05). A significant improvement of obesity-related clinical parameters and complete resolution of metabolic syndrome in both groups were noted. Both gastrointestinal quality of life increased significantly without any significant difference between the groups. The authors concluded that both LRYGB and MGB are effective for morbid obesity with similar results for resolution of metabolic syndrome and improvement of quality of life. MGB is a simpler and safer procedure that has no disadvantage compared with LRYGB at 2 years of follow-up.[13]

Shah M, *et al* (2006) conducted a review titled “Long-term impact of bariatric surgery on body weight, comorbidities, and nutritional status.” The articles were found via PubMed searches. To review the impact of bariatric surgery on weight maintenance and comorbidities, only articles with a postoperative follow-up of 3 yr or longer were included. The articles on nutritional status had a follow-up of 12 months or longer. The authors concluded that RYGB and GB surgeries lead to substantial weight loss in individuals with morbid obesity. However, significant weight regain occurs over the long term, and according to the only well-designed prospective controlled study, the improvement in comorbidities associated with weight loss mitigates in the long term on weight regain. There is some evidence from a retrospective study that RYGB surgery is associated with a modest decrease in long-term mortality. These results remain to be substantiated by well-designed, long-term, randomized and prospective controlled

studies. The mechanisms that lead to weight regain need to be further examined and may include increase in energy intake due to enlargement of stoma and adaptive changes in the levels of gut and adipocyte hormones such as ghrelin and leptin, which regulate energy intake; decrease in physical activity; changes in energy expenditure; and other factors. In addition to weight regain, RYGB surgery is associated with frequent incidence of iron, vitamin B12, folate, calcium, and vitamin D deficiency, which requires regular supplementation and monitoring.[14]

Riedt CS *et al* (2006) conducted a study titled "True fractional calcium absorption is decreased after Roux-en-Y gastric bypass surgery." Roux-en-Y gastric bypass (RYGB) is considered to be the gold standard alternative treatment for severe obesity. Weight loss after RYGB results primarily from decreased food intake. Inadequate calcium (Ca) intake and metabolic bone disease can occur after gastric bypass. To our knowledge, whether malabsorption of Ca contributes to an altered Ca metabolism in the RYGB patient has not been addressed previously. The authors recruited 25 extremely obese women in order to study true fractional Ca absorption (TFCA) before and 6 months after RYGB surgery, using a dual stable isotope method (^{42}Ca and ^{43}Ca) and test load of Ca (200 mg). Hormones regulating Ca absorption and markers of bone turnover were also measured. The results showed that In 21 women (BMI 52.7 ± 8.3 kg/m^2, age 43.9 ± 10.4 years) who successfully completed the study, TFCA decreased from 0.36 ± 0.08 to 0.24 ± 0.09 ($p < 0.001$) after RYGB. Bone turnover markers increased significantly ($p < 0.01$). TFCA correlated with estradiol levels ($r = 0.512$, $p < 0.02$) and tended to correlate with 1,25 $(OH)_2D$ ($r = 0.427$, $p < 0.06$) at final measurement. Stepwise linear regression indicated that estradiol explained 62% of the variance for TFCA at 6 months post-surgery ($p < 0.01$). The TFCA decreases (0.12 ± 0.08) after RYGB surgery but remains within normal range. Although only some patients were estimated to have low Ca absorption after surgery, all of the patients showed a dramatic increase in markers of bone resorption. The

alteration in Ca metabolism after RYGB induced weight loss appears to be regulated primarily by estradiol levels and might ultimately affect bone mass.[15]

Peterli R, *et al* (2009) conducted a study titled “Improvement in glucose metabolism after bariatric surgery: comparison of laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy: a prospective randomized trial.”In this randomized, prospective, parallel group study, the authors sought to evaluate and compare the effects of laparoscopic Roux-en-Y gastric bypass (LRYGB) with those of laparoscopic sleeve gastrectomy (LSG) on fasting, and meal-stimulated insulin, glucose, and glucagon-like peptide-1 (GLP-1) levels. Thirteen patients were randomized to LRYGB and 14 patients to LSG. The mostly nondiabetic patients were evaluated before, and 1 week and 3 months after surgery. A standard test meal was given after an overnight fast, and blood samples were collected before and after food intake in both groups for insulin, GLP-1, glucose, PYY, and ghrelin concentrations. The results showed that the body weight and body mass index decreased markedly ($P< 0.002$) and comparably after either procedure. Excess BMI loss was similar at 3 months (43.3 ± 12.1% vs. 39.4 ± 9.4%, $P> 0.36$). After surgery, patients had markedly increased postprandial plasma insulin and GLP-1 levels, respectively ($P< 0.01$) after both of these surgical procedures, which favor improved glucose homeostasis. Compared with LSG, LRYGB patients had early and augmented insulin responses as early as 1-week postoperative; potentially mediating improved early glycemic control. After 3 months, no significant difference was observed with respect to insulin and GLP-1 secretion between the 2 procedures. The authors concluded that both procedures markedly improved glucose homeostasis: insulin, GLP-1, and PYY levels increased similarly after either procedure. The study results do not support the idea that the proximal small intestine mediates the improvement in glucose homeostasis.[16]

Ernst B *et al* (2009) conducted a study titled “Evidence for the Necessity to Systematically Assess Micronutrient Status Prior to Bariatric Surgery.” Bariatric surgery has been proven the most effective treatment of morbid obesity, but micronutrient deficiency following bariatric surgery is a major concern. Increasing evidence points to a generally poor micronutrient status in obese subjects. The authors assessed micronutrient status in 232 morbidly obese subjects (BMI ≥ 35 kg/m^2) prior to bariatric surgery. Serum albumin, calcium, phosphate, magnesium, ferritin, hemoglobin, zinc, folate, vitamin B_{12}, 25-OH vitamin D_3, and intact parathormone (iPTH) were determined. In a sub-sample of 89 subjects, they additionally assessed copper, selenium, vitamin B_1, B_3, B_6, A, and E levels. The results showed that the deficiencies were found in 12.5% of the subjects for albumin, 8.0% for phosphate, 4.7% for magnesium, 6.9% for ferritin, 6.9% for haemoglobin, 24.6% for zinc, 3.4% for folate, and 18.1% for vitamin B_{12}. In addition, 25.4% showed a severe 25-OH vitamin D_3 deficiency, which was accompanied by a secondary hyperparathyroidism in 36.6% cases. Prevalence of albumin deficiency ($p < 0.007$) and of anemia ($p < 0.003$; in women only) significantly increased with BMI. Of note, 48.7% of the subjects showed at least one of the most prevalent deficiencies, i.e., vitamin B_{12}, zinc and severe 25-OH vitamin D_3 deficiency. In the sub-sample, 32.6% showed a selenium, 5.6% a vitamin B_3, 2.2% a vitamin B_6, and 2.2% a vitamin E deficiency. Copper, vitamin B_1, and vitamin A deficiency was found in none of the subjects. The authors concluded that the data indicate a high prevalence of micronutrient deficiencies in morbidly obese subjects. Based on these results, we strongly recommend a systematic assessment of the micronutrient status in all candidates for bariatric surgery.[17]

Hakeam HA *et al* (2009) conducted a study titled “Impact of Laparoscopic Sleeve Gastrectomy on Iron Indices: 1 Year Follow-Up.” The study was done to assess iron indices and the 1-year incidence of iron deficiency in patients undergoing LSG. This was a prospective, cohort study; patients

who underwent LSG from June 2007 to April 2008 at our institution were screened for inclusion. Preoperative haemoglobin and iron indices including serum iron, transferrin saturation, ferritin, and soluble transferrin receptor were compared to their levels at 6 and 12 months after surgery. Similarly, vitamin B12 and red blood cell (RBC) folate were analysed as secondary end points. Weight parameters and C-reactive protein (CRP) levels were compared before surgery and 1 year postoperatively. The results showed that a total of 61 patients were included in the study. One year after surgery, there was a significant decrease in the mean body mass index from 47.5 ± 9.6 to 30.5 ± 6.5 ($P < 0.001$). The incidence of iron deficiency was 4.9% at both follow-up time points. The anemia was evident in 4.9% of patients 1 year postoperatively. Significant decrease in the means of the natural logarithm of vitamin B12 and RBC folate were observed as early as 6 months after surgery ($P = 0.014$; $P < 0.005$, respectively). The decrease in mean CRP level 12 months postoperatively was statistically significant compared to its preoperative value ($P < 0.0001$). The authors concluded that LSG is an effective procedure for the treatment of morbid obesity and its associated inflammatory state. One year after surgery, development of iron deficiency was insignificant.[18]

Schweiger C *et al* (2010) conducted a study titled “Nutritional deficiencies in Bariatric Surgery candidates.” The study was conducted to assess the prevalence of nutritional deficiencies amongst people who suffer from morbid obesity and are candidates for bariatric surgery and to evaluate the relations between pre-operative nutritional deficiencies and demographic data and co-morbidities. The preoperative blood tests of 114 patients (83 women and 31 men) were collected. The blood tests included plasma chemistry (including albumin, total protein, iron, ferritin, vitamin B12, folic acid, parathyroid hormone (PTH), calcium, and phosphorous) and a blood count (for haemoglobin and mean corpuscular volume (MCV). The demographic and socio-economic details were collected from all

patients.The results showed that the mean age, weight, and BMI of the patients were 38 years (15-77), 122.9 kg (87-250), and 44.3 kg/m(2) (35.3-74.9), respectively. The prevalence of pre-operative nutritional deficiencies were: 35% for iron, 24% for folic acid, 24% for ferritin, 3.6% for vitamin B12, 2% for phosphorous, and 0.9% for calcium, Hb and MCV level was low in 19%. High levels of PTH were found among 39% of the patients. No hypoalbuminemia was encountered. Low iron was more common in females relative to men (40.8 vs.14.3%, p = 0.04) as well as ferritin levels (31.8 vs. 0%, p = 0.001). Men showed a greater prevalence of anemia (35.5% and 12% respectively, p = 0.01) relative to women. Patients with BMI > 50 kg/m^2 were at greater risk for low folic acid (OR = 14.57, 95% CI:1.4-151.34). Patients with high income were less likely to have iron deficiency (OR = 0.19, 95% CI:0.038-0.971). The authors concluded that a high prevalence of nutritional deficiencies was found amongst bariatric surgery candidates suffering from morbid obesity.[19]

Gehrer S *et al* (2010) conducted a study titled "Fewer Nutrient Deficiencies after Laparoscopic Sleeve Gastrectomy (LSG) than After Laparoscopic Roux-Y-Gastric Bypass (LRYGB)—A Prospective Study." The deficiencies in micronutrients after bariatric operations are frequent, despite routine supplementation. Main outcome measures were pre- and postoperative frequency of nutrient deficiencies and success rate of their treatment. Between 5/2004 and 12/2006, 136 patients (m:f = 0:4) with an average body mass index of 45 (35–58) kg/m^2 and age of 53 (21–66) years were prospectively analysed. The Laparoscopic Roux-Y-gastric bypass (LRYGB) was performed in 86 patients and laparoscopic sleeve gastrectomy (LSG) was performed in 50 patients. The patients were examined before surgery as well as 3, 6, 12, 24, 30, and 36 months postoperatively using a standard protocol including laboratory tests. The mean follow-up time was 24.4 (12–40) months; the follow-up rate was 100%. The results showed that prior to surgery, 57% of the patients had at least one deficiency, 23% of whom had vitamin D_3 deficiency. Frequent

postoperative deficiencies after LSG were zinc, vitamin D_3, folic acid, iron, and vitamin B_{12}; after LRYGB, vitamin B_{12}, vitamin D_3, zinc, and secondary hyperparathyroidism. No vitamin B_1 or B_6 deficiencies were found. Calcium levels were normal in all patients. Treatment of the deficiencies was mostly successful. The authors concluded that preoperatively, 57% of morbidly obese patients already had a deficiency. Postoperatively, significantly more vitamin B_{12} and vitamin D deficiencies and hyperparathyroidism were found in patients who had undergone LRYGB. After LSG, folate deficiency was more frequent (but not significantly so). Calcium levels were normal in all patients; therefore, parathyroid hormone and vitamin D_3 levels are more sensitive markers for early detection of disorders of calcium metabolism. Iron deficiency anaemia is most efficiently treated by IV therapy.[20]

Kehagias I *et al* (2011) conducted a study titled "Randomized clinical trial of laparoscopic Roux-en-Y gastric bypass versus laparoscopic sleeve gastrectomy for the management of patients with BMI<50 kg/m^2. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is currently the gold standard bariatric procedure for the treatment of morbid obesity. Laparoscopic sleeve gastrectomy (LSG) is a relatively innovative procedure which has been increasingly applied lately as a sole bariatric procedure. A randomized trial was conducted in a Greek population to evaluate perioperative safety and 3-years results. The Sixty patients with body mass index (BMI) ≤ 50 Kg/m^2 were randomized to LRYGB or LSG. Patients were monitored for 3 years postoperatively and throughout the study period weight loss, in terms of percent excess weight loss (%EWL), early and late complications, improvement of obesity related comorbidities and nutritional deficiencies were compared between groups. The results showed that there was no death in either group and there was no significant difference in early (10% after LRYGB and 13% after LSG, $P > 0.05$) and late morbidity (10% in each group). Weight loss was significantly better after LSG in the first years of the study and at 3 years

%EWL reached 62% after LRYGB and 68% after LSG ($p = 0.13$). There was no significant difference in the overall improvement of comorbidities. Nutritional deficiencies occurred at the same rate in the two groups except to vitamin B_{12} deficiency which was more common after LRYGB ($P = 0.05$). The authors concluded that LSG and LRYGB are equally safe and effective in the amelioration of comorbidities, while LSG is associated with fewer postoperative metabolic deficiencies, without the need of supplementation. Furthermore, LSG is a promising bariatric procedure, equally effective to LRYGB at 3 years follow up on weight reduction.[21]

Aarts EO *et al* (2011) conducted a study titled "The Gastric Sleeve: Losing Weight as Fast as Micronutrients?" From January 2005 to October 2008, 60 patients underwent LSG. All patients were instructed to take daily vitamin supplements. Patients were tested for micronutrient deficiencies 6 and 12 months after surgery. The results showed that anemia was diagnosed in 14 (26%) patients. Iron, folic acid, and vitamin B12 deficiency was found in 23 (43%), eight (15%), and five (9%) patients, respectively. Vitamin D and albumin deficiency was diagnosed in 21 (39%) and eight (15%) patients. The hypervitaminosis A, B1, and B6 were diagnosed in 26 (48%), 17 (31%), and 13 (30%) patients, respectively. The authors concluded that due to inadequate intake and uptake of micronutrients, patients who underwent LSG are at serious risk for developing micronutrient deficiencies. Moreover, some vitamins seem to increase to chronic elevated levels with possible complications in the long-term. Multivitamins and calcium tablets should be regarded only as a minimum and supplements especially for iron, vitamin B12, vitamin D, and calcium should be added to this regimen based on regular blood testing.[22]

Ruz M *et al* (2012) conducted a study titled "Heme- and nonheme-iron absorption and iron status 12 months after sleeve gastrectomy and Roux-en-Y gastric bypass in morbidly obese women." The objective was to study the effects of sleeve gastrectomy (SG) and Roux-en-Y gastric

bypass (RYGB) on heme- and nonheme-iron absorption and iron status. The Fifty-eight menstruating women were enrolled in this prospective study [mean (±SD) age: 35.9 ± 9.1 y; weight: 101.7 ± 13.5 kg; BMI (in kg/m^2): 39.9 ± 4.4]. Anthropometric, body-composition, dietary, and hematologic indexes and heme- and nonheme-iron absorption—using a standardized meal containing 3 mg Fe—were determined before and 12 mo after surgery. Forty-three subjects completed the 12-mo follow-up. Iron supplements were strictly controlled. The results showed that Heme-iron absorption was 23.9% before and 6.2% 12 mo after surgery ($P< 0.0001$). Nonheme-iron absorption decreased from 11.1% to 4.7% ($P< 0.0001$). No differences were observed by type of surgery. Iron intakes from all sources of supplements were 27.9 ± 6.2 mg/d in the SG group and 63.2 ± 21.1 mg/d in the RYGBP group ($P< 0.001$). Serum ferritin and total-body iron decreased more after RYGBP than after SG. The authors concluded that Iron (heme and nonheme) absorption is markedly reduced after SG and RYGB. The magnitude of the decrease in heme-iron absorption is greater than that of nonheme iron. The amounts suggested as iron supplements may need to be increased to effectively prevent iron-status impairment.[23]

Pech N *et al* (2012) conducted a study titled Complications reoperations, and Nutrient deficiencies two years after sleeve Gastrectomy." The aim of this study was to investigate patient outcomes and nutritional deficiencies following sleeve gastrectomy (SG) during a follow-up of two years. Over a period of 56 months, all consecutive patients who underwent SG were documented in this prospective, single-center, observational study. The study endpoints included operative time, complication rates, nutritional deficiencies and percentage of excess weight loss (% EWL). The results showed that from September 26, 2005 to May 28, 2009, 82 patients (female: male = 48:34) with a mean age of 43.3 years (range: 22–64) and a preoperative BMI of 52.5kg/m2 (range: 36.8–77.0) underwent SG. The major complications were observed in 9.8% of the patients, with 1 death.

During follow up 51.2% of patients were supplemented with iron, 36.6% with zinc, 37.8% with calcium, 26.8% with vitamin D, 46.3% with vitamin B12 and 41.5% with folic acid. %EWL was 54.3, 65.3 and 62.6% after 6, 12 and 24 months. The authors concluded that SG as a single step procedure is an effective bariatric intervention. Nutritional deficiencies after SG can be detected by routine nutritional screening. The study results show that Vitamin B12 supplementation should suggest routinely after SG.[24]

Moize V *et al* (2013) conducted a study titled “Long-term dietary intake and nutritional deficiencies following sleeve gastrectomy or Roux-en-Y gastric bypass in Mediterranean population.” The study was conducted to prospectively compare dietary changes and nutritional deficiencies in grade 3 obese patients 5 years after SG and Roux-en-Y gastric bypass (RYGB). Three hundred and fifty-five patients who had SG (n=61) or GB (n=294) (May 2001-December 2006) at a Spanish university hospital. The Changes in energy, macronutrient, and micronutrient intake, and weight loss were analysed using mixed models for repeated measurements. The results showed that at the 5-year follow-up visit, the percentage of excess weight loss (*P*=0.420) and daily energy intake (*P*=0.826), as well as the proportion of energy from carbohydrates (*P*=0.303), protein (*P*=0.600), and fat (*P*=0.541) did not differ between surgical groups. Energy intake (*P*=0.004), baseline weight (*P*<0.001), and time period (*P*<0.001), but not the proportion of different macronutrients or the type of surgery, independently predicted the percentage excess weight loss over time. After SG or RYGB, the mean daily dietary intake of calcium, magnesium, phosphorus, and iron was less than the current recommendations. Despite universal supplementation, the prevalence of nutritional deficiencies was comparable after SG or GB, with 25-hydroxyvitamin D being the most commonly observed deficiency (SG, 93.3% to 100%; RYGB, 90.9% to 85.7%, *P*=not significant). In an adjusted multivariate regression model, energy intake and lipid intake independently predicted plasma 25(OH)-

vitamin D levels. The authors concluded that the data show that SG and RYGB are associated with similar long-term weight loss with no differences in terms of dietary intake. Furthermore, data demonstrate that both types of surgeries carry comparable nutritional consequences.[25]

Lefebvre P *et al* (2014) conducted a study titled “Nutrient deficiencies in patients with obesity considering bariatric surgery: a cross-sectional study.” The objective of this study was to evaluate several vitamins, nutrients, and nutritional markers and their determinants in patients with obesity considering bariatric surgery. The preoperative values of fasting plasma glucose, insulin, lipid profile, 25-hydroxyvitamin D (25(OH)D), parathyroid hormone, thyroid-stimulating hormone, calcium, phosphate, albumin, magnesium, total proteins, liver function tests, iron, ferritin, folate, vitamin A, vitamin B12, selenium, and zinc were evaluated in 267 Caucasian outpatients (74.2% women, aged 40.5±12.6 years) who were considering bariatric surgery. The determinants of nutrient variability were analyzed by linear regression for nutrients with a prevalence of deficiency>10%, i.e., serum 25(OH)D, iron, phosphate, magnesium, and vitamin A. the results showed that the prevalence of inadequate concentrations was high for 25(OH)D (67.9% with values ≤ 20 ng/mL), magnesium (35.4%), phosphate (21.6%), iron (18.8%), and vitamin A (16.9%). The multiple deficiencies were common; 28.5%, 12.1%, and 6.3% of patients had 2, 3, and 4 deficiencies, respectively. In multivariate analyses, metabolic characteristics had an important impact on deficiencies, with lower values of 25(OH)D and vitamin A with increasing body mass index, lower values of 25(OH)D and magnesium with increasing fasting plasma glucose, and a positive correlation between vitamin A and triglycerides. Elevated TSH was associated with low iron concentrations. The authors concluded that at all ages, micronutrient deficiencies were common, with high prevalence of concentration inadequacies for 25(OH)D, magnesium, phosphate, iron, and vitamin A. The high body mass index and high fasting plasma glucose increased the

risk of deficiencies; particularly for 25(OH)D. Preoperative screening and correction of deficiencies should be advised.[26]

Kwon Y *et al* (2014) conducted a study titled “Anemia, Iron and Vitamin B12 Deficiencies after Sleeve Gastrectomy compared to Roux-en-Y Gastric Bypass: A Meta-Analysis.” The effective treatment of postoperative anemia and nutritional deficiencies is critical for the successful management of bariatric patients. However, the evidence for nutritional risk or support of bariatric patients remains scarce. The aims of this study were to assess current evidence of the association between 2 methods of bariatric surgery, sleeve gastrectomy (SG) and Roux-en-Y gastric bypass (RYGB), and postoperative anemia and nutritional deficiencies. The MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials were searched for English-language studies using a list of keywords. Reference lists from relevant review articles were also searched. In the authors' meta-analysis, they included studies with a duration of>12 months, those comparing SG with RYGB, and those with available outcome data for postoperative anemia and iron and vitamin B12 deficiencies. Of 36 potentially relevant studies, 9 met the inclusion criteria. Data were combined by means of a fixed-effects model or random-effects model. The results showed that compared with the SG group, the odds ratio for postoperative vitamin B12 deficiency in the RYGB group was 3.55 (95% confidence interval, 1.26-10.01; P<.001). In the subgroup analysis, studies in which prophylactic iron or vitamin B12 was administered lost significance in the odds ratio for postoperative vitamin B12 deficiency. The authors' findings suggest that SG is more beneficial than RYGB with regard to postoperative vitamin B12 deficiency risk, whereas the 2 methods are comparable with regard to the risk of postoperative anemia and iron deficiency. Postoperative prophylactic iron and B12 supplementation, in addition to general multivitamin and mineral supplementation, is recommended based on the comparable deficiency risk of the 2 methods as indicated by subgroup analysis.[27]

Vix M *et al* (2014) conducted a study titled “Impact of Roux-en-Y gastric bypass versus sleeve gastrectomy on vitamin D metabolism: short-term results from a prospective randomized clinical trial.” The study was conducted to assess postoperative outcomes of sleeve gastrectomy (SG) versus Roux-en-Y gastric bypass (RYGB). Short-term results on vitamin D and parathormone (PTH) metabolism are reported. The one hundred patients were randomly assigned to RYGB (n = 45) or SG (n = 55). Vitamin D, PTH, and calcium were assessed at inclusion and after 1, 3, 6, and 12 months (M1, M3, M6, and M12). Eighty-eight patients completed 1-year follow-up. The results showed that mean postoperative excess weight loss (%EWL) at M1, M3, M6, and M12 was 25.39, 43.47, 63.75, and 80.38 % versus 25.25, 51.32, 64.67, and 82.97 % in RYGB and SG, respectively. Vitamin D values were statistically significantly higher after SG compared to RYGB at M3 (61.57 pmol/L, standard deviation [SD] 14.29 vs. 54.81 SD 7.65; p = 0.01) and M12 (59.83 pmol/L, SD 6.41 vs. 56.15 SD 8.18; p = 0.02). Vitamin D deficiency rate decreased from 84.62 to 35 % at M6 (p = 0.04) and 48 % at M12 (p = 0.01) in the SG group, while there was no significant improvement in the RYGB group. The serum parathyroid hormone (sPTH) level was decreased significantly in the SG group by M3 (44.8 ng/L vs. 28.6; p = 0.03), M6 (44.9 ng/L vs. 25.8; p = 0.017), and M12 (41.4 ng/L vs. 20.5; p = 0.017). Secondary hyperparathyroidism rate was 20.83 and 24 % at M1 (p = 1), 16.67 and 8 % at M3 (p = 0.41), 14.29 and 0 % at M6 (p = 0.08), and 15 and 0 % at M12 (p = 0.23) in the RYGB and SG groups, respectively. The authors concluded that thepatients after RYGB had a significantly higher postoperative vitamin D deficiency and higher sPTH levels than after SG.[28]

Coupaye M *et al* (2014) conducted a study titled “Comparison of nutritional status during the first year after sleeve gastrectomy and Roux-en-Y gastric bypass.” The sleeve gastrectomy (SG) is supposed to induce fewer nutritional deficiencies than gastric bypass (RYGB). However, few

studies have compared nutritional status after these two procedures, and the difference in weight loss (WL) between procedures may alter the results. Thus, the aim was to compare nutritional status after SG and RYGB in subjects matched for postoperative weight. Forty-three subjects who underwent SG were matched for age, gender, and 6-month postoperative weight with 43 subjects who underwent RYGB. Dietary intakes (DI), metabolic (MP), and nutritional parameters (NP) were recorded before and at 6 and 12 months after both procedures. Multivitamin supplements were systematically prescribed after surgery. Before surgery, BMI, DI, MP, and NP were similar between both groups. After surgery, LDL cholesterol, serum prealbumin, vitamin B12, urinary calcium, and vitamin D concentrations were lower after RYGB than after SG, whereas WL and DI were similar after both procedures. However, the total number of deficiencies did not increase after surgery regardless of the procedure. In addition, we found a significant increase in liver enzymes and a greater decrease in C-reactive protein after RYGB. In conclusion, during the first year after surgery, in patients with the same WL and following the same strategy of vitamin supplementation, global nutritional status was only slightly impaired after SG and RYGB. However, some nutritional parameters were specifically altered after RYGB, which could be related to malabsorption or other mechanisms, such as alterations in liver metabolism.[29]

Park JY *et al* (2015) conducted a study titled “Laparoscopic Gastric Bypass vs Sleeve Gastrectomy in Obese Korean patients. The study was conducted to compare the mid-term outcomes of laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) in obese Korean patients. All consecutive patients who underwent either LSG or LRYGB with primary to treat morbid obesity between January 2011 and December 2012 were retrospectively reviewed. Patients with a body mass index (BMI) ≥ 30 kg/m(2) with inadequately controlled obesity-related comorbidities (e.g., diabetes, obstructive sleep apnea,

hypertension, or obesity-related arthropathy) or BMI ≥ 35 kg/m(2) were considered for bariatric surgery according to the International Federation for the Surgery of Obesity-Asia Pacific Chapter Consensus statements in 2011. The decision regarding the procedure type was made on an individual basis following extensive discussion with the patient about the specific risks associated with each procedure. All operative procedures were performed laparoscopically by a single surgeon experienced in upper gastrointestinal surgeries. Baseline demographics, perioperative surgical outcomes, and postoperative anthropometric data from a prospectively established database were thoroughly reviewed and compared between the two surgical approaches. The results showed that one hundred four patients underwent LSG, and 236 underwent LRYGB. Preoperative BMI in the LSG group was significantly higher than that of the LRYGB group (38.6 kg/m(2) vs 37.2 kg/m(2), P = 0.024). Patients with diabetes were more prevalent in the LRYGB group (18.3% vs 35.6%, P = 0.001). Operating time and hospital stay were significantly shorter in the LSG group compared with the LRYGB group (100 min vs 130 min, P < 0.001; 1 d vs 2 d, P = 0.003), but the incidence of perioperative complications was similar between the groups (P = 0.351). The mean percentage of excess weight loss (%EWL) was 71.2% for LRYGB, while it was 63.5% for LSG, at mean follow-up periods of 18.0 and 21.0 mo, respectively (P = 0.073). The %EWL at 1, 3, 6, 12, 18, 24, and 36 mo was equivalent between the groups. Four patients required surgical revision after LSG (4.8%), while revision was only required in one case following LRYGB (0.4%; P = 0.011). The authors concluded that both LSG and LRYGB are effective procedures that induce comparable weight loss in the mid-term and similar surgical risks, except for the higher revision rate after LSG.[30]

Wang C *et al* (2016) conducted a study titled “Prevalence of Electrolyte and Nutritional deficiencies in Chinese Bariatric Surgery candidates.” The study was conducted to investigate the prevalence of electrolyte and nutritional deficiencies in Chinese bariatric surgery candidates and to

explore their associations with patients' demographic data. The demographical data of 211 patients presenting for bariatric surgery were collected on gender, age, body mass index (BMI) and waist circumference (WC). Blood biochemical data were collected on some nutrients (haemoglobin, albumin, globulin, folate, vitamin B12, calcium, phosphorus, iron, ferritin, magnesium, parathyroid hormone [PTH], and vitamin D) and some electrolytes (potassium, sodium, and chloride). The results showed that deficiencies were found for haemoglobin (2.8%), albumin (11.8%), globulin (1.4%), folate (32.2%), vitamin B12 (4.7%), corrected calcium (13.7%), phosphorus (10.4%), iron (9.0%), ferritin (1.9%), vitamin D (80.0%), potassium (5.7%), sodium (7.6%), and chloride (15.6%). Secondary hyperparathyroidism was found in 17.3%; no hypomagnesemia was encountered. A significant correlation was observed between age and folate, corrected calcium and PTH levels (r = .257, -.206, and .273, respectively; P<.05). Greater BMI was associated with lower albumin and folate (r = -.338 and -.370, respectively) and with higher globulin and phosphorus levels (r = .267 and .138, respectively). The folate deficiency was more common in the 18- to 30-year-old age group (P = .042) and the patients with BMI > 45 kg/m^2 (P = .001). WC had an association with rates of albumin, folate, and corrected calcium deficiencies, as well as hemoglobin, albumin, and globulin, folate, phosphorus, and ferritin levels. The authors concluded that the electrolyte and nutritional deficiencies are common in Chinese bariatric surgery candidates. Routine evaluation of electrolyte and nutritional levels should be carried out in this population.[31]

Inge TH, *et al* (2016) conducted a study titled “Weight loss and healthy status 3 years after bariatric surgery in adolescents. The authors prospectively enrolled 242 adolescents undergoing weight-loss surgery at five U.S. centers. The patients undergoing Roux-en-Y gastric bypass (161 participants) or sleeve gastrectomy (67) were included in the analysis. The changes in body weight, coexisting conditions, cardiometabolic risk factors, and weight-related quality of life and postoperative complications

were evaluated through 3 years after the procedure. The results showed that the mean (±SD) baseline age of the participants was 17±1.6 years, and the mean body-mass index (the weight in kilograms divided by the square of the height in meters) was 53; 75% of the participants were female, and 72% were white. At 3 years after the procedure, the mean weight had decreased by 27% (95% confidence interval [CI], 25 to 29) in the total cohort, by 28% (95% CI, 25 to 30) among participants who underwent gastric bypass, and by 26% (95% CI, 22 to 30) among those who underwent sleeve gastrectomy. By 3 years after the procedure, remission of type 2 diabetes occurred in 95% (95% CI, 85 to 100) of participants who had had the condition at baseline, remission of abnormal kidney function occurred in 86% (95% CI, 72 to 100), remission of prediabetes in 76% (95% CI, 56 to 97), remission of elevated blood pressure in 74% (95% CI, 64 to 84), and remission of dyslipidemia in 66% (95% CI, 57 to 74). Weight-related quality of life also improved significantly. However, at 3 years after the bariatric procedure, hypoferritinemia was found in 57% (95% CI, 50 to 65) of the participants, and 13% (95% CI, 9 to 18) of the participants had undergone one or more additional intraabdominal procedures. The authors concluded that in this multicenter, prospective study of bariatric surgery in adolescents, we found significant improvements in weight, cardiometabolic health, and weight-related quality of life at 3 years after the procedure. Risks associated with surgery included specific micronutrient deficiencies and the need for additional abdominal procedures.[32]

Goldberg HR *et al* (2017) conducted a study titled **"**Bariatric Surgery in Adolescents: Is routine nutrient supplementation sufficient to avoid anemia following bariatric surgery?" The purpose of this study was to investigate if routine multivitamin supplementation is sufficient to prevent anemia in adolescents undergoing bariatric surgery, particularly sleeve gastrectomy (SG), a procedure that may induce nutrient malabsorption. The authors conducted a retrospective review of medical records of pediatric patients

who underwent SG (34 patients) and laparoscopic adjustable gastric banding (LAGB) (141 patients) (1/2006–12/2013). They examined anemia marker levels (iron, ferritin, folate, B_{12}, haemoglobin and hematocrit) at first visit, 3, 6, and 12 months post-surgery by repeated measures analysis adjusting for weight loss. The results showed that following SG, folate levels decreased 3 and 6 months post-surgery, however returned to baseline levels at 12 months. Furthermore, SG patients demonstrated lower folate levels compared to LAGB at 3 and 6 months. B_{12} levels decreased 6 months post-SG, however returned to baseline at 12 months. Following LAGB, B_{12} levels decreased 12 months post-surgery compared baseline. Ferritin levels decreased 3 months post-LAGB, however returned to baseline levels at 6 months. There were no changes within groups or differences between groups in iron, hemoglobin or hematocrit. The authors concluded that while anemia did not occur in any patients while on recommended routine supplementation, folate levels were significantly reduced following SG and were lower in SG compared to LAGB patients. Additional folate supplementation seemed to improve folate levels, which highlights the importance of ongoing surveillance by primary care providers and the need for additional folate supplementation following SG.[33]

Lupoli R *et al* (2017) conducted a review titled “Bariatric surgery and long-term nutritional issues.” According to the authors, Bariatric surgery is recognized as a highly effective therapy for obesity since it accomplishes sustained weight loss, reduction of obesity-related comorbidities and mortality, and improvement of quality of life. Overall, bariatric surgery is associated with a 42% reduction of the cardiovascular risk and 30% reduction of all-cause mortality. This review focuses on some nutritional consequences that can occur in bariatric patients that could potentially hinder the clinical benefits of this therapeutic option. All bariatric procedures, to variable degrees, alter the anatomy and physiology of the gastrointestinal tract; this alteration makes these patients more

susceptible to developing nutritional complications, namely, deficiencies of macro- and micro-nutrients, which could lead to disabling diseases such as anemia, osteoporosis, protein malnutrition. Of note is the evidence that most obese patients present a number of nutritional deficits already prior to surgery, the most important being vitamin D and iron deficiencies. This finding prompts the need for a complete nutritional assessment and, eventually, an adequate correction of pre-existing deficits before surgery. Another critical issue that follows bariatric surgery is post-operative weight regain, which is commonly associated with the relapse of obesity-related co-morbidities. The nutritional complications associated with bariatric surgery can be prevented by life-long nutritional monitoring with the administration of multi-vitamins and mineral supplements according to the patient's needs.[34]

Al Khalifa K *et al* (2018) conducted a study titled **"**Quality of Life, Food Tolerance, and eating disorder behavior after Laparoscopic Gastric Banding and Sleeve Gastrectomy - Results from a Middle Eastern Center of Excellence." The obesity is a major health problem in Arab countries. Bariatric surgery can improve the quality of life of an obese individual. However, different types of bariatric surgery result in varying levels of food intolerance as a side effect. Many patients who undergo bariatric surgery are also at risk of subsequently developing eating disorder behaviors. The aim of the study was to compare the quality of life, food tolerance, and behaviors of eating disorders related to laparoscopic sleeve gastrectomy and gastric banding. A retrospective review of medical records and a questionnaire-based survey was completed for all patients who had undergone either bariatric sleeve gastrectomy or gastric banding at the Bahrain Defense Force Hospital between 2011 and 2014. Each patient was administered 3 questionnaires to assess the quality of life, food tolerance, and eating disorder behaviors. The results showed that forty-eight patients who had undergone sleeve gastrectomy and 36 who had undergone gastric banding participated in the study. Sleeve gastrectomy

patients showed better food tolerance (*P*< 0.001) and better eating behaviors (*P* = 0.001) post-surgery compared with gastric banding patients. Health-related quality of life (HRQOL) did not differ significantly between the 2 groups. Only sleeve patients had preoperative evaluation of these parameters (HRQOL). However, in the gastric sleeve group, after the surgery, significant improvement was found in all parameters of HRQOL except for mental health status. The authors concluded that laparoscopic gastric sleeve surgery patients had superior outcomes in both food tolerance and eating disorder behaviors. The quality of life did not significantly differ between the gastric sleeve and gastric banding surgery groups.[35]

Karbaschian Z *et al* (2018) conducted a study titled "Probiotic Supplementation in Morbid Obese patients Undergoing One Anastomosis Gastric Bypass-Mini Gastric Bypass (OAGB-MGB) Surgery: a Randomized, Double-Blind, Placebo-Controlled, Clinical Trial." This study was designed to examine the effects of probiotic supplementation on some morbidities related to this surgery. This was a placebo-controlled, double-blind, randomized clinical trial on morbid obese patients referred for One Anastomosis Gastric Bypass- Mini Gastric Bypass (OAGB-MGB) surgery to a tertiary referral center. The patients were assigned to receive a probiotic supplement (Familact®) or placebo from 4 weeks prior to surgery to 12 weeks after surgery. Anthropometric, biochemical, and inflammatory indices were evaluated at the beginning and the end of the study. The results showed that at the end of study, significant improvements in some serum inflammatory markers, vitamin D status, and anthropometric measurements were observed ($p < 0.05$), which were significantly more in probiotic group rather than placebo group ($p < 0.05$). Moreover, significant improvements in glycemic indices and lipid profile were observed in both groups; however, these changes were not significantly different between the groups. There was no significant difference in serum levels of vitamin B_{12}, folate, and homocysteine

between groups at week 16 of the study. The authors suggested that the results indicate that probiotic supplementation promotes inflammatory markers, body weight loss, and status of vitamin D in patients undergoing OAGB-MGB bypass. Whether these findings will sustain in longer treatment duration remained to be elucidated in future studies.[36]

Ferraz AAB *et al* (2018) conducted a study titled "Micronutrient deficiencies following bariatric surgery: a comparative analysis between sleeve gastrectomy and Roux-en-Y gastric bypass." The study was conducted to compare the prevalence of micronutrient deficiencies in patients submitted to sleeve gastrectomy (SG) and Roux- en-Y gastric bypass (RYGB). Its a comparative study of 576 patients submitted to bariatric surgery, 338 to SG and 238 to RYGB, and evaluated for hemoglobin, iron, ferritin, zinc and vitamin B12 serum levels. The authors performed these dosages in the preoperative period and at three, six, 12 and 24 months after surgery, for analysis and comparison of micronutrient deficiencies among the techniques. The results showed that the SG group consisted of 48 men and 290 women, with a mean BMI of 39.4±2.6kg/m2, and a mean of age of 37.2±11 years; the group RYGB consisted of 77 men and 161 women, with mean BMI 42.7±5.9kg/m2, and a mean age of 41.9±11.1 years. After 24 months, hemoglobin deficiency was present in 24.4% of the patients submitted to SG and in 40% of the RYGB individuals (p=0.054); iron deficiency was present in 6,6% of SG patients and in 15% of RYGB ones (p=0.127); ferritin deficiency occurred in 17.8% of the SG group and in 23.7% of RYGB one (p=0.399); the Zinc deficiency incidence was 6.6% in SG and 30% in RYGB (p=0.002); and B12 deficiency took place in 6.6% the SG patients and in 8.7% of RYGB ones (p=0.844). The authors concluded that patients undergoing SG had serum levels of iron and zinc superior to the ones undergoing RYGB, the prevalence of the latter micronutrient deficit being significantly higher in the RYGB group.[37]

Aridi H D *et al* (2018) conducted a study titled "Comparison of Outcomes between Laparoscopic Roux-en-Y Gastric Bypass and Sleeve

Gastrectomy in a Lebanese Bariatric surgical practice." The aim of this study is to compare the outcomes of laparoscopic Roux-en-Y gastric bypass (LRYGB) and sleeve gastrectomy (LSG) up to 5 years of follow-up. A retrospective analysis of patients who underwent LRYGB and LSG was performed. The primary outcome was weight loss. Postoperative complications, operative time, and hospital length of stay were secondary outcomes. The results showed that four hundred patients underwent primary LSG and 175 patients underwent LRYGB between 2008 and 2013. Follow-up rates at 5 years were around 60%. Percent total weight loss was similar after 3, 4, and 5 years in both groups, averaging around 28%. Mean percentage of excess weight loss (%EWL) at 5 years was 72.0 ± 31.0% in the LSG group vs. 63.0 ± 21.0% in the LRYGB group ($p = 0.03$). Patients undergoing LRYGB had a significantly longer operative time as well as a longer hospital stay. No significant difference was found in the rates of short- and long-term complications between the two groups. However, patients undergoing LRYGB were more likely to develop small intestinal obstruction and iron-deficiency anemia. Authors concluded that both LSG and LRYGB result in satisfactory weight loss within 5 years. Patients' comorbidities and potential risks must be included in the choice of the appropriate bariatric procedure. LSG appears to give durable weight loss with less risk of major long-term complications.[38]

Mostafa EA*, et al* (2019) conducted a study titled "Laproscopic sleeve gastrectomy verses laproscopic mini gastric bypass in management of morbid obesity and its comorbidities." Laparoscopic mini gastric bypass (MGB) is gaining popularity among the bariatric procedures today, and laparoscopic sleeve gastrectomy (SG) as a single stage procedure for the treatment of morbid obesity is becoming increasingly popular. Patients and methods Between October 2016 and July 2018, 50 obese patients were randomized, operated upon, and followed up for 12 months in Al Zahraa Hospital and Shebin El Kom teaching Hospital. A total of 25 patients underwent SG, and 25 patients underwent MGB. The mean BMI

of all patients was 47.8±5.5kg/m^2, their mean age was 30 ± 8.3 years, and 80% of them were female. The patients were followed up at 1, 3, 6, 9, and 12 months. The operative time, length of hospital stays, weight loss, comorbidity improvement or resolution, postoperative complications, reinterventions, and mortality were evaluated. The results showed that age, sex, BMI, and comorbidities were equal. The mean operative time for SG was 86.9±51.6 min and that for MGB was 108.4±41.8 min; the percentage of 1year excess weight loss was similar (76.2 ± 4.49% for SG and 80.3 ± 8.3% for MGB). The comorbidities were significantly improved after both procedures; exceptfor type 2 diabetes mellitus, which showed a higher resolution rate after MGB. The authors concluded that laparoscopic SG regarding excess weight loss is comparable to laparoscopic MGB in short term follow up (1 year) with less metabolic effect.[39]

Bhandari M *et al* (2019) conducted a study titled “Laparoscopic sleeve gastrectomy versus laparoscopic gastric bypass: A retrospective cohort study.” This study compared the outcomes from laparoscopic sleeve gastrectomy (LSG) and laparoscopic gastric bypass (LGB) in a cohort of patients who had surgery in 2011 with a six-year follow up. The data on patients who had either LSG or LGB at a single centre in Mohak Bariatric and Robotic Surgery Centre, Indore, M.P. India in 2011 were identified from a database of routinely collected data. This retrospective cohort was analysed for weight loss, resolution of comorbidities and nutritional status over six years. The patients who had revision operations or for whom six-year follow-up data were not available were excluded from the analysis. The results showed that 154 patients had LGB and 152 had LSG. The six-year follow up rate was 61.7% (n = 95) and 64.5% (n = 98) respectively for LGB and LSG. The percentage of excess bodyweight loss (%EWL) peaked at approximately 70% after two years in the LSG group and after three years in the LGB group. However, after six years %EWL was 61% for LGB and 50% for LSG (p = 0.001). Resolution of type-2 diabetes was

more common in the LGB group compared to the LSG group (79% vs 62%, $p = 0.126$). The resolution of hypertension and dyslipidaemia was similar in both groups at approximately half of patients in each group for each condition. The nutrient deficiencies were found in both groups but were generally more pronounced in the LGB group. The authors concluded that LGB is a better operation for weight loss, weight loss maintenance, and resolution of type-2 diabetes than LSG. This is at the expense of an increased incidence of nutrient deficiencies. LSG appears to have greater treatment failure by six years follow up and this should be further investigated.[40]

Kim G. *et al* (2019) conducted a study titled "Sleeve Gastrectomy and Roux-En-Y Gastric Bypass Lead to Comparable Changes in Body Composition in a Multiethnic Asian Population." The aim of authors was to study changes in body composition in a multiethnic Asian cohort following bariatric surgery and to identify differences between laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass.A retrospective review of prospectively collected data on 295 patients who underwent either laparoscopic sleeve gastrectomy (256 patients) or laparoscopic Roux-en-Y gastric bypass (39 patients) was performed. Body composition variables were measured with the analyzer, GAIA 359 PLUS, which included the parameters; total body weight, body mass index, excess weight, basal metabolic rate, fat-free mass, fat mass, and total body water. The results showed that there were no statistical differences in gender, ethnicity, age, weight, height, and body mass index between laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass. At each time point (6, 12, 24, and 36 months) post-operation, there was no significant differences in % total body weight loss, basal metabolic rate, fat mass, fat percentage, and total body water between sleeve gastrectomy and bypass patients. There was significant difference ($p < 0.05$) in fat free mass only at 3 years post-operation, with sleeve gastrectomy patients having 9.79 kg less fat-free mass than bypass patients. However, after multivariate

analysis, we found no statistically significant differences. The authors concluded that sleeve gastrectomy and gastric bypass seemed to give similar changes to body composition.[41]

Paredes SCS *et al* (2020) conducted a study titled “Metabolic syndrome impact on nutritional deficiencies and metabolic status 1 year after sleeve gastrectomy.” The study was conducted to compare the nutritional status in patients with and without MetS before and 1 year after SG and to investigate its association with metabolic status. Retrospective study, including all patients submitted to SG between January 2011 and July 2015. Patients were evaluated before and 12 months after surgery. MetS presence was classified using the International Diabetes Federation/American Heart Association/National Heart, Lung, and Blood Institute 2009 definition. Univariate and multivariate analyses were applied to find associations between MetS, nutritional, anthropometric, and metabolic parameters. The results showed thata total of 330 patients were included and MetS was present in 47%. Preoperatively, patients without MetS presented a higher percentage of folate deficiency (12% versus 2%, *P*< .001). Follow-up data were available for 202 patients. In the 1-year evaluation, MetS patients presented significantly lower body mass index and percent excess weight loss (70.96 ± 20.4 versus 79.55 ± 23.0, *P*< .001). These patients also presented lower homocysteine (11.76 ± 4.3 versus 13.66 ± 7.6, *P* = .027) and magnesium (19.41 ± 2.1 versus 20.22 ± 1.9, *P* = .004) levels but higher calcium (9.27 ± .3 versus 9.16 ± .4, *P* = .031) and vitamin B12 (396, P 312–504.5 versus 329, P 255–433, *P* = .002) levels comparing with those without MetS. Multiple linear regression evidenced that higher preoperative albumin and postoperative ferritin and homocysteine were predictors of a lower body mass index after surgery, and higher postoperative folate levels were associated with lower insulin-resistance. The authors concluded that the impact of SG on nutritional parameters is affected by MetS. If not treated, preoperative deficiencies can impair postoperative metabolic status and weight loss. MetS should

be considered when evaluating bariatric surgery candidates, and preoperative supplementation and long-term nutritional follow-up are required to prevent further nutritional deficiencies.[42]

Gu L *et al* (2020) conducted a review titled “In Terms of Nutrition, the Most Suitable Method for Bariatric Surgery: Laparoscopic Sleeve Gastrectomy or Roux-en-Y Gastric Bypass?” This study assesses the differences in postoperative nutritional status between laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB). We searched the literature from PubMed, Web of Science, Embase, and the Cochrane Library database. Twenty-nine articles were included, with a total of 5437 obese patients. After bariatric surgery, the LSG group had less anemia and iron deficiency anemia than the LRYGB group. The serum iron, ferritin deficiency, and vitamin B_{12} rates after LSG were lower than patients receiving LRYGB. And PTH and serum phosphorus concentration of patients after LSG were both lower than those after LRYGB. The postoperative results of LSG were better than that of LRYGB. Therefore, we recommend LSG for a better postoperative nutrition, but only for reference.[43]

MATERIALS AND METHODS

The present study was a time bound study and conducted in the Department of General Surgery of The Dayanand Medical College & Hospital, Ludhiana. It was a prospective study and done between September 2018 and May 2020.

Inclusion criteria for the present study: 1. Consent to participate in the study. 2. Patients with BMI ≥ 40, or BMI ≥ 35. 3. Patients within age group of 18–60 years

Exclusion Criteria for the present study: 1. Patient who were not coming for follow-up. 2. Patients who haven't given consent to participate in study. 3. Past history of any bariatric surgical intervention. 4. Patients suffering from terminal illness. 5. Patients who were unable to understand the nature of bariatric surgery or the behavioral changes required afterwards, including untreated schizophrenia, active substance abuse. 6. Patients opting out of the study at any time during the study

OPERATIVE TECHNIQUE

1. **LAPAROSCOPIC SLEEVE GASTRECTOMY**

After visual access to the intraperitoneal space using a 12 mm visi pod trocar 18 cm below the left hypochondrium, the abdomen will be insufflated to 15-20mmHg. Then two 12mm ports and two 5mm ports will be placed per abdomen, and a Nathanson liver retractor will be inserted through a 5mm skin Incision in the subxiphoid location to retract the left lateral segment of liver. Although there are minor variations of the LSG procedure, in general 75%- 80% of the greater curvature is excised leaving a narrow stomach tube. A point on the greater curvature, on the antrum, is chosen as a starting point. This has previously been described as ranging from 2-10cm from the pylorus. The lesser sac is entered by opening the gastro colic ligament. The short gastric vessels and the greater curvature ligaments are then divided with ultrasonic dissection to the left crus. A 32 French bougie is then passed transorally into the

pylorus. Placed against the lesser curvature. A laparoscopic stapler with a green cartage (4.8 mm closed staple height) followed by white cartages is introduced and is fired consecutively along the length of the bougie until the angle of His is reached at this point, about 75%-80% of the stomach has been separated. The specimen is removed by enlarging one of the 12-mm ports. A drain is then placed alongside the staple line.

2. **LAPAROSCOPIC MINI-GASTRIC BYPASS**

The technique used for LMGB was a 5-port technique similar to that described by Rutledge. A long gastric tube was created using an Endo GIA stapler approximately 1.5 cm to the left of the lesser curvature from the antrum to the angle of His. A loop gastroenterostomy was created with the small bowel about 200 cm distal to the ligament of Trietz with an Endo-GIA stapler. The gastroenterostomy was then closed with continuous suture. One hemovac drain was left in the lesser sac before closure of the wound.

SOURCE OF DATA

Examinations were conducted preoperatively at 0 and postoperatively at 3 and 6 months after surgery. Weight, height and triceps fold thickness was measured and fasting blood samples were drawn at all visits.

METHOD OF COLLECTION OF DATA

Particulars of each patient were duly noted including name, age, sex, occupation, admission number and address for future correspondence. A written informed consent was taken from all the patients.

Blood and serum samples were assessed both preoperatively and postoperatively. Both Macronutrients (Protein, albumin) and micronutrients (ferritin, Folic acid and Vitamin B12) were assessed. Post-operative assessment of the samples was done at 3 months and 6 months.

RANGE AND PRINCIPLE OF NUTRITIONAL PARAMETERS:

TOTAL PROTEIN (6.0-8.3g/dL): Done on COBAS C system

Divalent copper reacts in alkaline solution with protein peptide bonds to form the characteristic purple-colored biuret complex. sodium potassium

tartrate prevents the ppt of copper hydroxide and potassium iodide prevents autoreduction of copper. the color intensity is directly proportional to the protein concentration. Which can be determined photometrically.

ALBUMIN (3.4-5.4 g/dL) : Done on COBAS C system

Anti-albumin antibodies react with the antigen in the sample to form antigen/antibody complexes which, following agglutination are measured turbidimetrically.

FOLIC ACID (2.7-17.0 ng/mL): done on COBAS e 411 system

1st incubation: By incubating 25µL of sample with the folate pretreatment reagents 1 and 2, bound folate is released from endogenous folate binding proteins

2nd incubation: By incubating the pretreated sample with the ruthenium labelled folate binding protein, folate complex is formed, the amount of which is dependent upon the analyte concentration In the sample.

3rd incubation: After addition of streptavidin -coated microparticles and folate labeled with biotin, the unbound sites of the ruthenium labelled folate binding protein become occupied, with formation of a ruthenium labeled folate binding protein-folate biotin complex. The entire complex becomes bound to the solid phase via interaction of biotin and streptavidin.

The reaction mixture is aspirated into the cell where microparticles are magnetically captured onto the surface of the electrode.

Unbound substances are then removed with ProCell/ProCell M. Application of a voltage induces chemiluminescent emission

Results are determined via calibration curve generated by 2 point calibration and master curve via reagent barcode.

CALCIUM (8.5-10.3 mg/dL): done on COBAS c 701/702 system

Calcium ion react with 5-nitro-5-methyl-BAPTA under alkaline conditions to form complex. This reaction reacts in the second step with EDTA.

The change in absorbance is directly proportional to the calcium concentration and is measured photometrically.

VITAMIN B12 (160-950 pg/mL) **AND FERRITIN (**20-500 ng/mL**):** both done on COBAS e 411 system.

Ist incubation: 10µL sample, a biotinylated monoclonal ferritin-specific antibody, and a monoclonal ferritin -specific antibody labeled with a ruthenium complex form a sandwich complex (for ferritin)

30µL sample, biotinylated monoclonal anti-holotranscobalmin antibody and monoclonal anti-transcobalamin antibody labelled with a ruthenium complex reacts to form sandwich complex.(for vitamin b12)

2^{nd} incubation: after addition of streptavidin-coated microparticles, the complex becomes bound to the solid phase via interaction of biotin and streptavidin.

The reaction mixture is aspirated into the cell where microparticles are magnetically captured onto the surface of the electrode. Unbound substances are then removed with ProCell/ProCell M. Application of a voltage induces chemiluminescent emission

Results are determined via calibration curve generated by 2-point calibration and master curve via reagent barcode

OUTCOME: The outcome of the study was assessed from the following parameters:

1. Micronutrients (ferritin, Folic acid and Vitamin B12)
2. Macronutrients (Protein, albumin)
3. Post-operative nutritional deficiencies to be recorded at each follow up visit up till 6 months from the date of surgery.

STATISTICAL ANALYSIS

The data obtained from the study was subjected to statistical analysis using SPSS version 20.0, for further evaluation. The data was presented as mean ± standard deviation for continuous variables and frequency for categorical variables. For categorical data, Chi square statistical analysis was done. Comparative analysis was done using one sample student's t test.

OBSERVATIONS AND RESULTS

The present study was conducted in Department of Surgery, DMCH Ludhiana, over a period of one and half year from September 2018 to May 2020. 25 morbidly obese patients underwent bariatric surgery were enrolled and were followed up for 6 months. Results of the study are presented below:

AGE:

In our study, maximum number of patients 11(44%) were in age group more than 60, while 10(40%) belonged to age group below 40 years and 4(16%) to the age group 41-50 years. This is depicted in **Table no 1 and Figure no 1.**

TABLE 1: AGE WISE DISTRIBUTION OF PATIENTS

Age	No. of cases	Percentage
< 40	10	40.0%
41-50	4	16.0%
> 60	11	44.0%
Total	25	100.0%

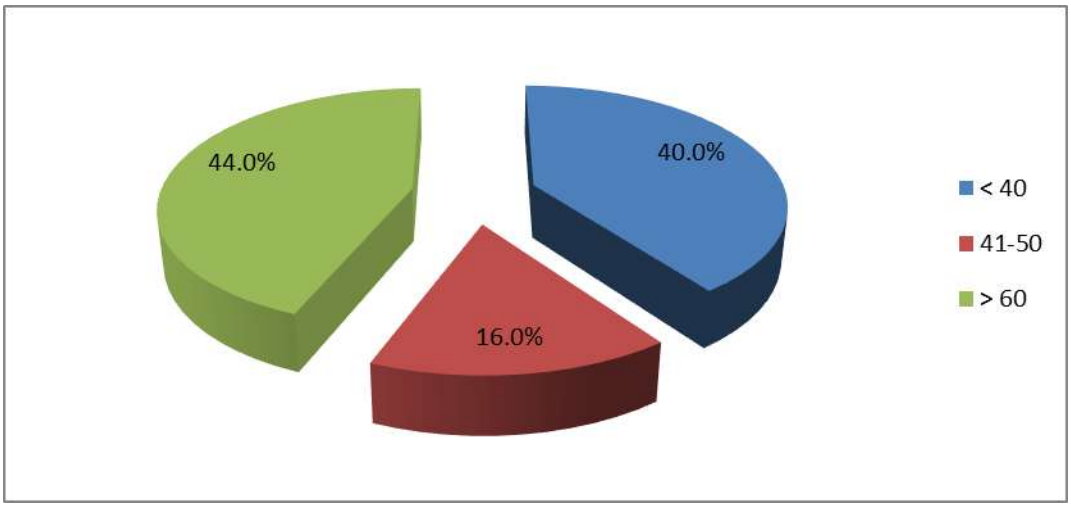

FIGURE 1: AGE WISE DISTRIBUTION OF PATIENTS

GENDER

Table no. 2 and Figure no. 2 shows that Females constituted the majority of our case load at 13 (81.3%) for mini gastric bypass and 5 (55.6%) for sleeve gastrectomy while males formed a smaller proportion of the case load at 3(18.8%) for mini gastric bypass and 4 (44.4%) for sleeve gastrectomy. Chi square test was conducted to observe level of significance between both the study groups. An insignificant relation (p-value.>0.05) was observed statistically.

TABLE 2: GENDER WISE DISTRIBUTION OF PATIENTS

		Surgery performed				Total	Chi-square value	p-value
		MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY				
Sex	FEMALE	13	81.3%	5	55.6%	18	1.886	0.170
	MALE	3	18.8%	4	44.4%	7		

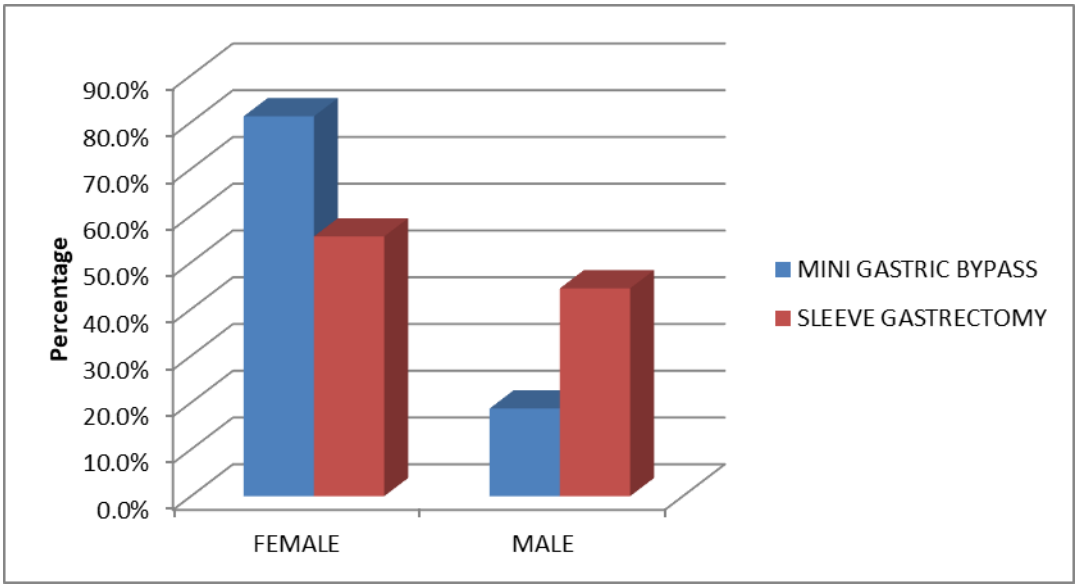

FIGURE 2: GENDER WISE DISTRIBUTION OF PATIENTS BETWEEN TWO GROUPS

SURGERY PERFORMED

Of the total number of patients enrolled in our study, 16 patients (64%) underwent Mini gastric bypass, 9 patients (36%) underwent Sleeve gastrectomy as shown in **table 3 and figure 3**.

TABLE 3: NUMBER OF PATIENTS ACCORDING TO SURGERY PERFORMED

Surgery performed	No. of cases	Percentage
Mini gastric bypass	16	64.0%
Sleeve gastrectomy	9	36.0%
Total	25	100.0%

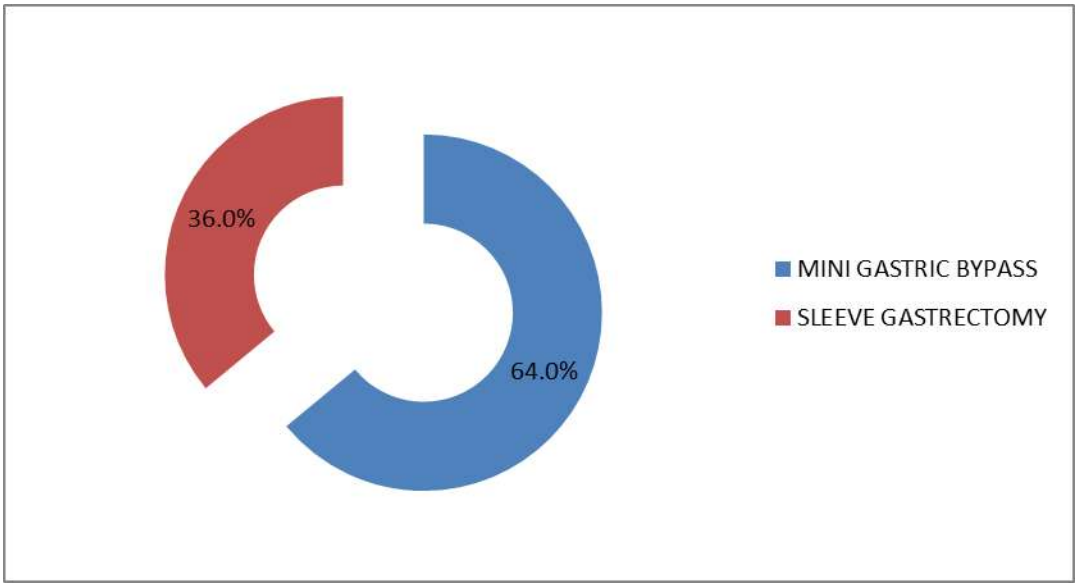

FIGURE 3: NUMBER OF PATIENTS ACCORDING TO SURGERY PERFORMED

CHANGES IN WEIGHT

Table no. 4 and Figure no. 4 shows the comparison of weight loss between two study groups. Weight was recorded before surgical intervention for both the groups 116.69±25.47kg and 115.27±8.73kg respectively, with an insignificant difference statistically (p-value>0.05). Weight after mini gastric bypass and sleeve gastrectomy was 96.20±17.51kg and 96.07±5.52kgrespectively at 3 months post operative and 86.93±12.33kg and 87.78±6.30kg respectively at 6 months post operative, which was not significantly different (p>0.05) statistically. Weight loss after mini gastric bypass and sleeve gastrectomy was 19.27±10.17 & 19.20±5.97 respectively at 3 months and 28.53±16.01 & 27.49±7.56 respectively at 6 months which was not significantly different (p>0.05).

TABLE 4: CHANGES IN WEIGHT

Weight	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	116.69	25.47	115.27	8.73	0.161	0.874	1.42	8.84	-16.86	19.70
3 Months Post Op	96.20	17.51	96.07	5.52	0.022	0.983	0.13	6.06	-12.43	12.69
6 Months Post Op	86.93	12.33	87.78	6.30	-0.190	0.851	-0.84	4.44	-10.06	8.37
3 month difference	19.27	10.17	19.20	5.97	0.018	0.986	0.07	3.74	-7.69	7.83
6 month difference	28.53	16.01	27.49	7.56	0.183	0.857	1.04	5.72	-10.81	12.90

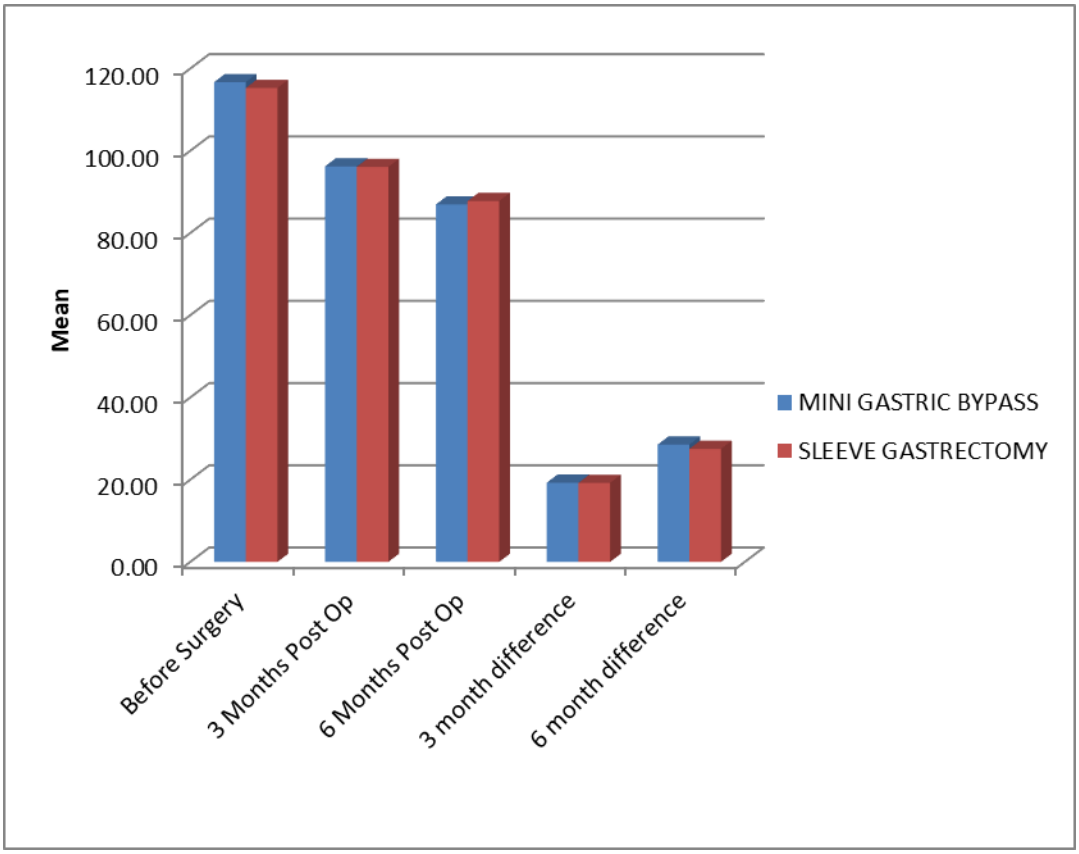

FIGURE 4: COMPARISON OF PRE & POST OPERATIVE WEIGHT OF PATIENTS BETWEEN TWO SURGERY GROUPS

CHANGES IN BODY MASS INDEX

BMI (Body Mass Index) is calculated by weight (in kg) divided by height (in m2)

Table no. 5 and Figure no. 5 shows Changes in BMI was recorded before surgical intervention for both the groups was 47.35±10.76 and49.42±5.51 respectively, with an insignificant difference statistically (p-value>0.05). BMI after mini gastric bypass and sleeve gastrectomy was 39.55±7.41 and 40.69±3.57 respectively at 3 months postoperative and 35.72±4.77 and 37.18±3.65 respectively at 6 months postoperative, which was not significantly different (p>0.05) statistically.

Out of the 25 patients, fall in BMI after mini gastric bypass and sleeve gastrectomy was 7.44±4.18 & 8.73±3.49 respectively at 3 months and 11.27±6.91 & 12.24±3.84 respectively at 6 months which was not significantly different(p>0.05)

TABLE 5: CHANGES IN BMI BETWEEN TWO SURGERY GROUPS

BMI	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	47.35	10.76	49.42	5.51	-0.536	0.597	-2.07	3.87	-10.07	5.92
3 Months Post Op	39.55	7.41	40.69	3.57	-0.428	0.673	-1.14	2.65	-6.63	4.36
6 Months Post Op	35.72	4.77	37.18	3.65	-0.786	0.440	-1.46	1.85	-5.30	2.39
3month difference	7.44	4.18	8.73	3.49	-0.778	0.445	-1.29	1.66	-4.74	2.16
6 month difference	11.27	6.91	12.24	3.84	-0.385	0.704	-0.97	2.52	-6.20	4.25

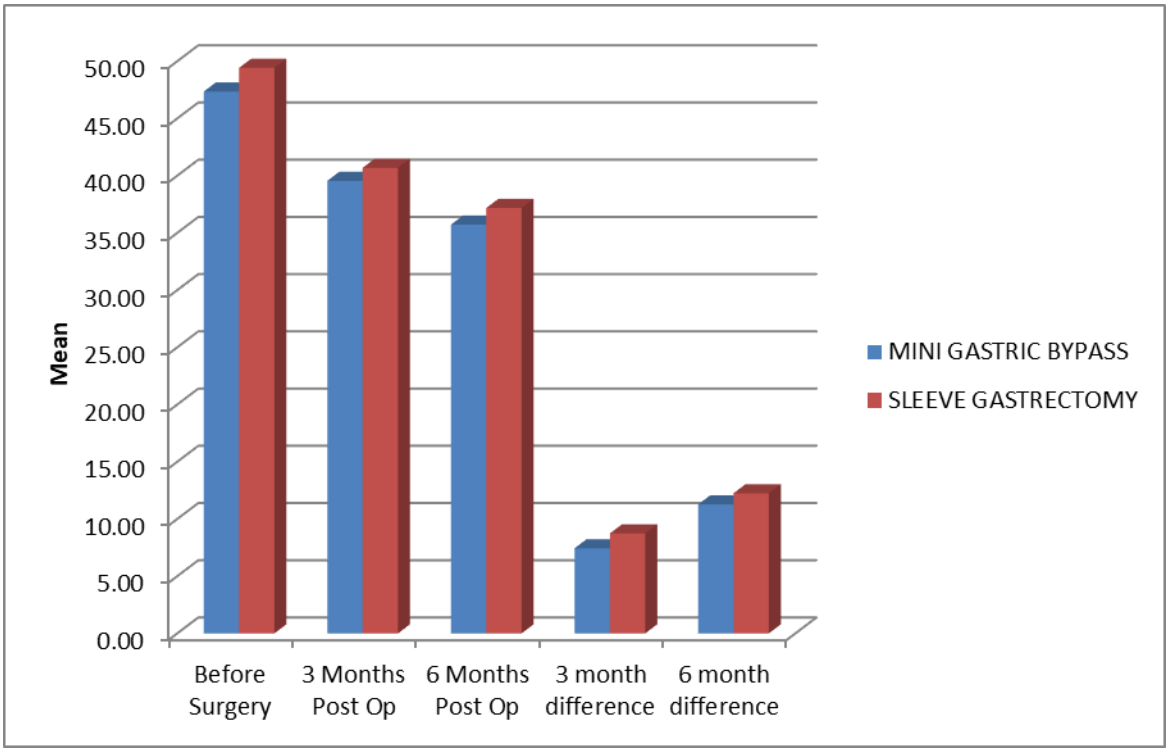

FIGURE 5: COMPARISON OF PRE & POST OPERATIVE BMI BETWEEN TWO SURGERY GROUPS

CHANGES IN TRICEPS FOLD THICKNESS

Triceps Fold Thickness is calculated by measured at the back of the left arm, midway between the acromial process of the scapula and the olecranon process of the ulna

Table no. 6 and Figure no. 6 shows Triceps Fold Thickness was recorded before surgical intervention for both the groups 38.69±4.38 and 40.33±3.32 respectively, with an insignificant difference statistically (p-value>0.05). Triceps Fold Thickness after mini gastric bypass and sleeve gastrectomy was 34.93±3.95and 36.44±2.70 respectively at 3 months post operative and 30.07±3.45 and 34.67±2.45 respectively at 6 months post operative, which was a significant different ($p<0.05$) statistically. Of the 25 patients studied, fall in triceps fold thickness after mini gastric bypass and sleeve gastrectomy was 3.87±1.25mm & 3.89±1.17mm respectively at 3 months which was not significantly different ($p>0.05$) but fall in triceps fold thickness at 6 months was 8.73±1.98mm & 5.67±1.12mm which was significantly different($p<0.05$)

TABLE 6: CHANGES IN TRICEPS FOLD THICKNESS BETWEEN TWO SURGERY GROUPS

Triceps	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	38.69	4.38	40.33	3.32	-0.978	0.338	-1.65	1.68	-5.13	1.84
3 Months Post Op	34.93	3.95	36.44	2.70	-1.010	0.324	-1.51	1.50	-4.61	1.59
6 Months Post Op	30.07	3.45	34.67	2.45	-3.490	0.002	-4.60	1.32	-7.33	-1.87
3 month difference	3.87	1.25	3.89	1.17	-0.043	0.966	-0.02	0.51	-1.09	1.04
6 month difference	8.73	1.98	5.67	1.12	4.234	0.000	3.07	0.72	1.56	4.57

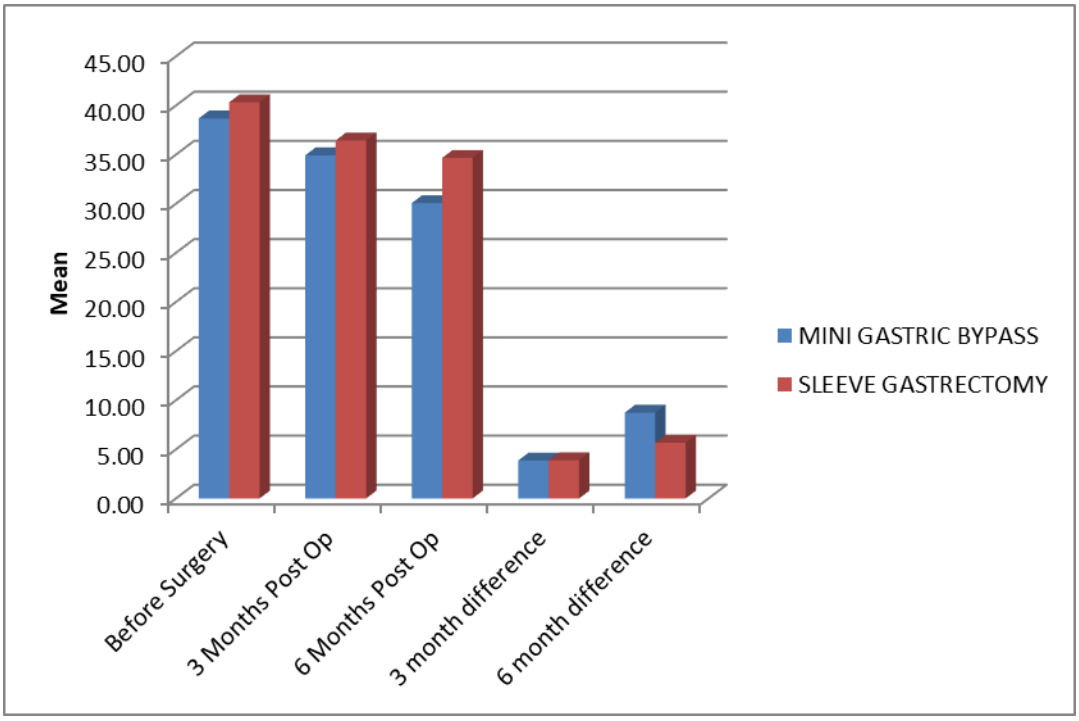

FIGURE 6: COMPARISON OF PRE & POST OPERATIVE TRICEPS FOLD THICKNESS BETWEEN TWO SURGERY GROUPS

CHANGES IN TOTAL PROTEIN

Mean fall of total protein levels during mini gastric bypass from 7.32 g/dL to 6.91 g/dL& 6.38 g/dL at 3 months and 6 months while mean fall in total protein during sleeve gastrectomy from 7.39 g/dL to 7.23 g/dL&7.11 g/dL at 3 months and 6 months as shown in **Table no. 7 and Figure no. 7**. At 3 months, mean difference was observed to be 0.43±0.28 and0.16±0.37 for both the groups, with a statistically significant relation (p-value<0.05). At 6 months, mean difference was observed to be 0.97±0.50 and0.28±0.35 for both the groups, with a statistically significant relation (p-value<0.05).it shows that fall was more during follow up of mini gastric bypass than sleeve gastrectomy.

TABLE 7: CHANGES IN TOTAL PROTEIN LEVEL BETWEEN TWO SURGERY GROUPS

Total Protein	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	7.32	0.52	7.39	0.43	-0.341	0.736	-0.07	0.21	-0.50	0.35
3 Months Post Op	6.91	0.51	7.23	0.28	-1.738	0.096	-0.32	0.18	-0.70	0.06
6 Months Post Op	6.38	0.44	7.11	0.35	-4.221	0.000	-0.73	0.17	-1.09	-0.37
3 month difference	0.43	0.28	0.16	0.37	2.085	0.049	0.28	0.13	0.00	0.55
6 month difference	0.97	0.50	0.28	0.35	3.609	0.002	0.69	0.19	0.29	1.08

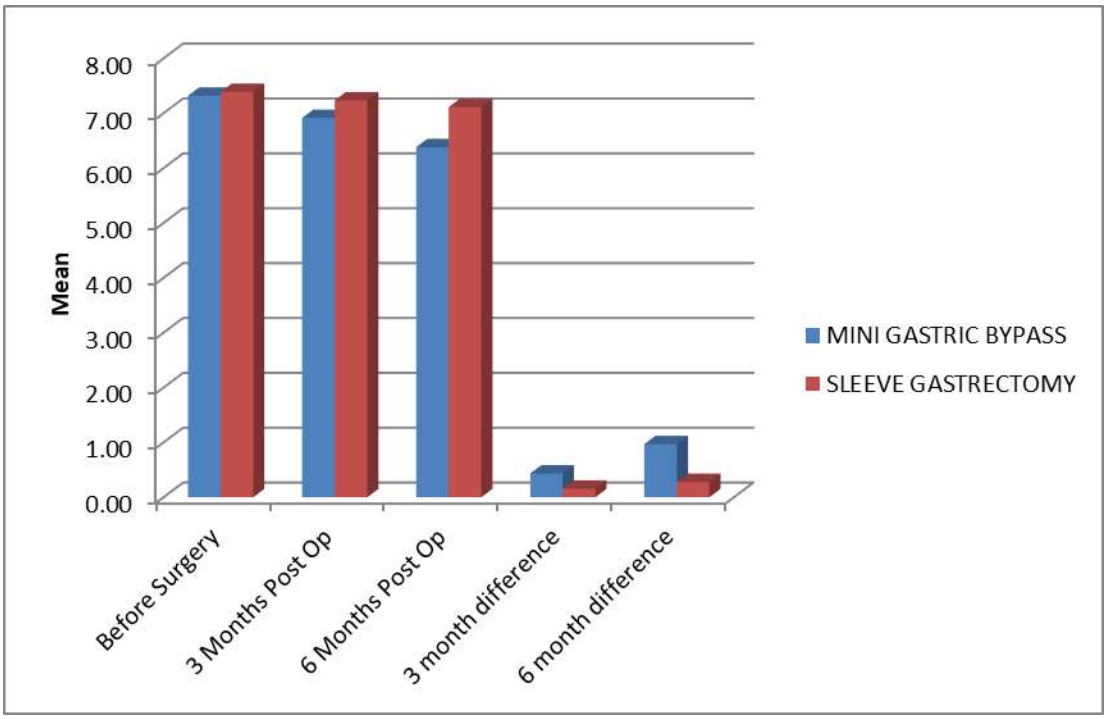

FIGURE 7: COMPARISON OF PRE & POST OPERATIVE TOTAL PROTEIN LEVELS BETWEEN TWO SURGERY GROUPS

CHANGES IN ALBUMIN

Table no. 8 and Figure no. 8shows albumin levels before surgical intervention for both the groups 4.00±0.58g/dL and 4.15±0.40g/dL respectively, with an insignificant difference statistically (p-value>0.05). Albumin levels after mini gastric bypass and sleeve gastrectomy was 3.67±0.33g/dL and 4.18±0.47g/dL respectively at 3 months post operative and 3.52±0.13g/dL and 3.97±0.16g/dL respectively at 6 months post operative, which was having an significant different ($p<0.05$) statistically. Albumin levels at 3 months difference was found to be 0.43±0.37 and -0.03±0.32respectively for both the groups with a statistically significant different ($p<0.05$). Albumin levels at 6 months difference was found to be 0.58±0.36 and 0.19±0.27respectively for both the groups with a statistically significant different ($p<0.05$).

TABLE 8: CHANGES IN ALBUMIN LEVELS BETWEEN TWO SURGERY GROUPS

Albumin	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	4.00	0.58	4.15	0.40	-0.695	0.494	-0.15	0.22	-0.61	0.30
3 Months Post Op	3.67	0.12	4.18	0.39	-4.773	0.000	-0.51	0.11	-0.73	-0.29
6 Months Post Op	3.52	0.13	3.97	0.16	-7.534	0.000	-0.45	0.06	-0.57	-0.32
3 month difference	0.43	0.37	-0.03	0.32	3.101	0.005	0.46	0.15	0.15	0.77
6 month difference	0.58	0.36	0.19	0.27	2.840	0.010	0.40	0.14	0.11	0.69

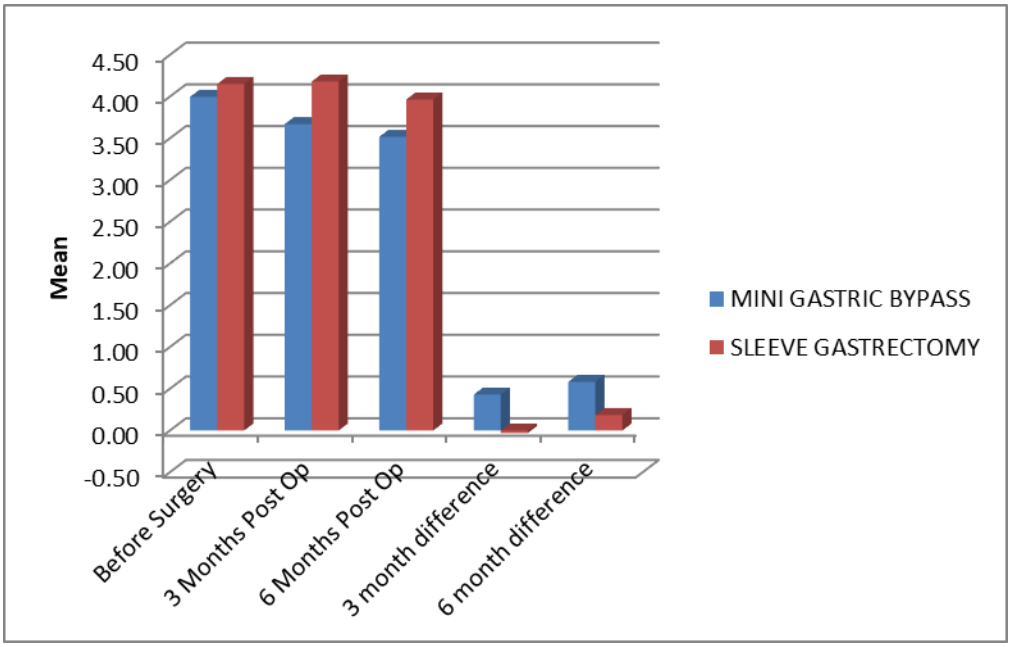

FIGURE 8: COMPARISON OF PRE & POST OPERATIVE ALBUMIN LEVELS BETWEEN TWO SURGERY GROUPS

CHANGES IN FERRITIN

Table no. 9 and Figure no. 9shows ferritin levels before surgical intervention for both the groups 39.61±25.59 and52.26±24.56 respectively, with an insignificant difference statistically (p-value>0.05). Ferritin levels after mini gastric bypass and sleeve gastrectomy was 34.73±20.30and 50.86±23.78 respectively at 3 months post operative; and 28.69±17.59 and 49.37±22.67 respectively at 6 months post operative, which was having a significant different ($p<0.05$) statistically. Ferritin levels at 3 months difference was found to be 6.59±7.20and 1.40±1.50 respectively for both the groups with a statistically significant difference ($p<0.05$). Ferritin levels at 6 months difference was found to be 12.63±10.55 and 2.89±3.30 respectively for both the groups with a statistically significant difference ($p<0.05$).

TABLE 9: CHANGES IN FERRITIN LEVELS BETWEEN TWO SURGERY GROUPS

Ferritin	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	39.61	25.59	52.26	24.56	-1.203	0.241	-12.65	10.51	-34.40	9.10
3 Months Post Op	34.73	20.30	50.86	23.78	-1.769	0.091	-16.13	9.12	-35.04	2.78
6 Months Post Op	28.69	17.59	49.37	22.67	-2.504	0.020	-20.68	8.26	-37.81	-3.55
3 month difference	6.59	7.20	1.40	1.50	2.114	0.046	5.19	2.45	0.10	10.27
6 month difference	12.63	10.55	2.89	3.30	2.670	0.014	9.74	3.65	2.18	17.30

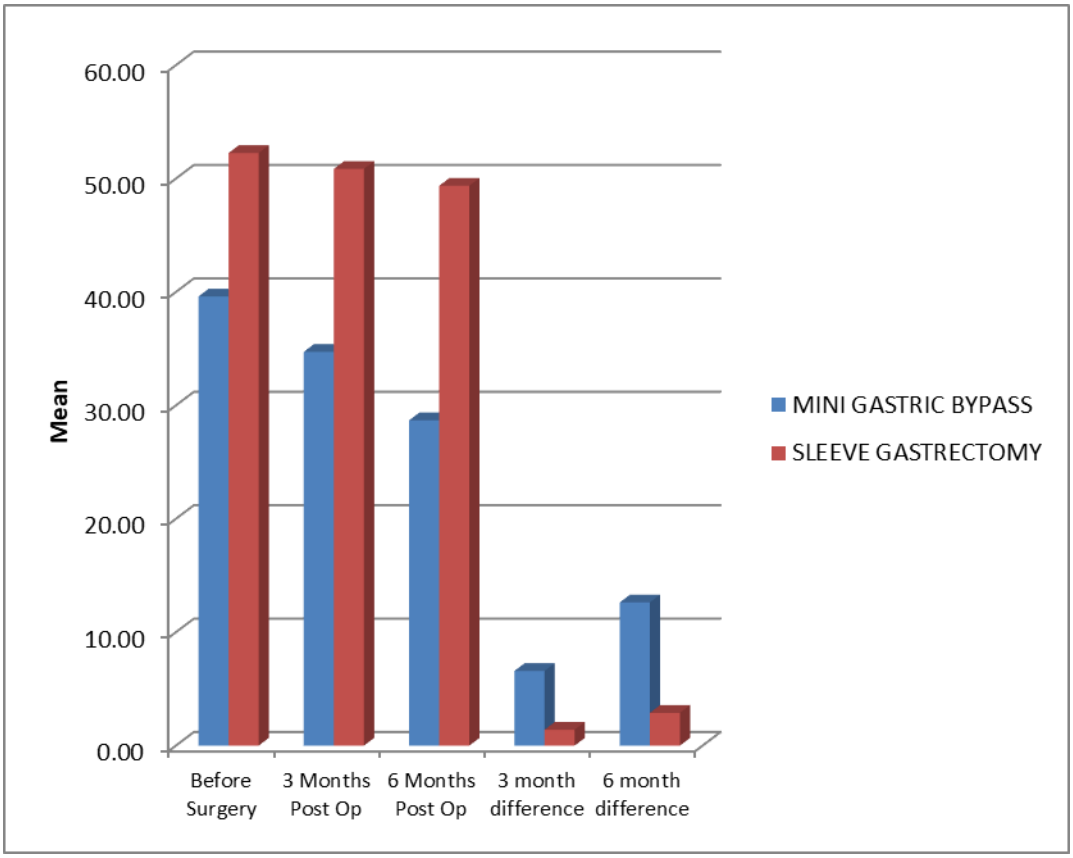

FIGURE 9: COMPARISON OF PRE & POST OPERATIVE FERRITIN LEVELS BETWEEN TWO SURGERY GROUPS

CHANGES IN FOLIC ACID

Table no. 10 and Figure no. 10shows Mean fall of folic acid levels during mini gastric bypass from 8.27 ng/mL to 6.88ng/mL& 6.58 ng/mL at 3 months and 6 months while mean fall in folic acid during sleeve gastrectomy from 9.80 ng/mL to 9.57ng/mL& 9.33 ng/mL at 3 months and 6 months which was insignificantly different. there was significant fall in difference of folic acid during mini gastric bypass and sleeve gastrectomy of 1.75 ±1.70 , 2.05 ± 1.93 &0.23 ± 1.04 ,0.47 ±2.272 at 3 and 6 months respectively($p<0.05$).

TABLE 10: CHANGES IN FOLIC ACID

Folic Acid	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	8.27	4.52	9.80	4.60	-0.805	0.429	-1.53	1.90	-5.45	2.39
3 Months Post Op	6.88	3.22	9.57	3.78	-1.853	0.077	-2.69	1.45	-5.69	0.32
6 Months Post Op	6.58	3.32	9.33	4.21	-1.779	0.089	-2.75	1.55	-5.96	0.46
3 month difference	1.75	1.70	0.23	1.04	2.408	0.025	1.52	0.63	0.21	2.82
6 month difference	2.05	1.93	0.47	1.02	2.272	0.033	1.58	0.70	0.14	3.03

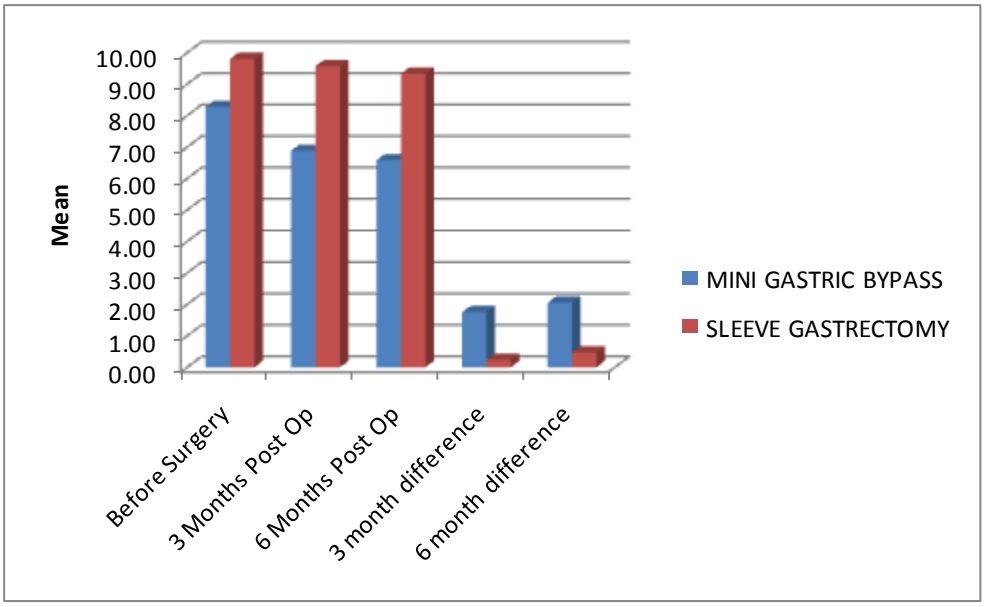

FIGURE 10: COMPARISON OF PRE AND POST OPERATIVE FOLIC ACID LEVELS AMONG TWO SURGERY GROUPS

CHANGES IN VITAMIN B12

Table no. 11 and Figure no. 11shows before surgery, levels of vitamin B12 were 275.81±134.89pg/mL and 271.54±74.90pg/mL. At 3months postoperative, 241.71±142.29pg/mLand261.56±70.10pg/mL. At 6 months postoperative, 216.65±130.32pg/mLand 242.72±76.22pg/mL. Difference in vitamin B12 during mini gastric bypass and sleeve gastrectomy was 41.31±26.23 &9.99±8.60 at 3 months and 66.37±25.43 &28.83±16.97 respectively with significant difference statistically($p<0.05$).

TABLE 11: CHANGES IN VITAMIN B12 LEVELS BETWEEN TWO SURGERY GROUPS

Vitamin B12	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	275.81	134.89	271.54	74.90	0.087	0.931	4.27	48.98	-97.05	105.58
3 Months Post Op	241.71	142.29	261.56	70.10	-0.389	0.701	-19.84	51.07	-125.76	86.07
6 Months Post Op	216.65	130.32	242.72	76.22	-0.544	0.592	-26.07	47.92	-125.46	73.32
3 month difference	41.31	26.23	9.99	8.60	3.446	0.002	31.32	9.09	12.47	50.18
6 month difference	66.37	25.43	28.82	16.97	3.919	0.001	37.55	9.58	17.68	57.42

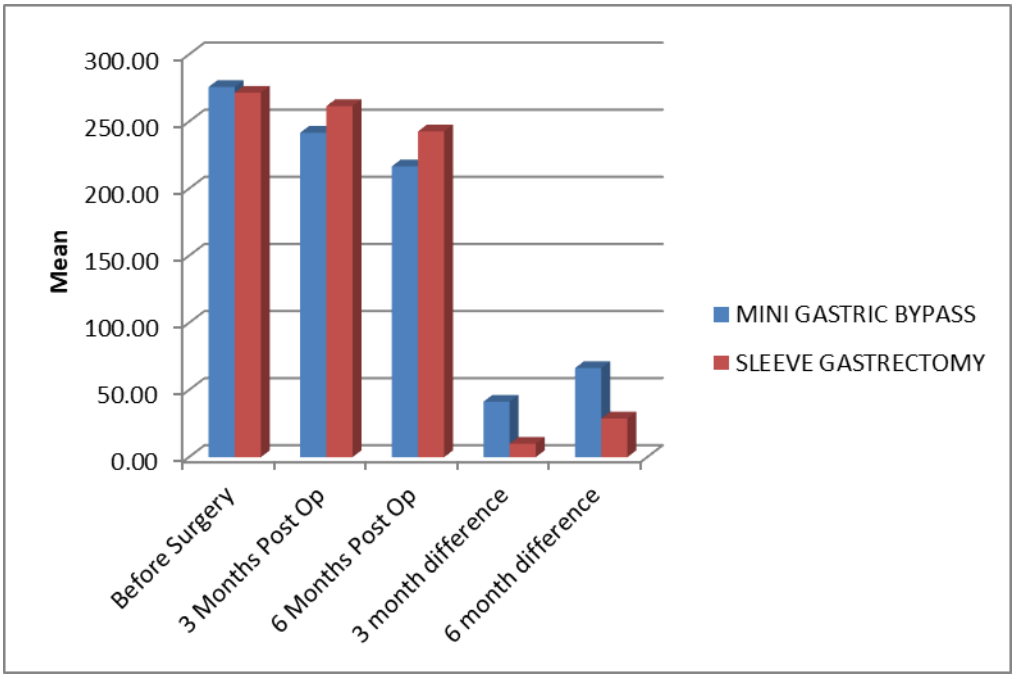

FIGURE 11: COMPARISON OF PRE & POST OPERATIVE VITAMIN B12 LEVELS BETWEEN TWO SURGERY GROUPS

CHANGES IN CALCIUM

Table no. 12 and Figure no. 12shows Mean calcium during mini gastric bypass from 8.73mg/dL at surgery to 8.07mg/dL& 7.83mg/dL at 3 months and 6 months while mean calcium during sleeve gastrectomy from 8.71mg/dL at surgery to 8.57mg/dL&8.36mg/dL at 3 months and 6 months. There was a significant difference in calcium levels during mini gastric bypass and sleeve gastrectomy of 0.61±0.51&0.14±0.12 at 3 months and at 6 months as 0.85± 0.43 & 0.36±0.20respectively statistically($p<0.05$).

TABLE 12: CHANGES IN CALCIUM BETWEEN TWO SURGERY GROUPS

Calcium	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	8.73	0.49	8.71	0.50	0.068	0.947	0.01	0.21	-0.41	0.44
3 Months Post Op	8.07	0.60	8.57	0.48	-2.091	0.048	-0.49	0.24	-0.98	-0.00
6 Months Post Op	7.83	0.51	8.36	0.41	-2.623	0.016	-053	0.20	-0.95	-0.11
3 month difference	0.61	0.51	0.14	0.12	2.648	0.015	0.46	0.17	0.10	0.82
6 month difference	0.85	0.43	0.36	0.20	3.230	0.004	0.50	0.15	0.18	0.82

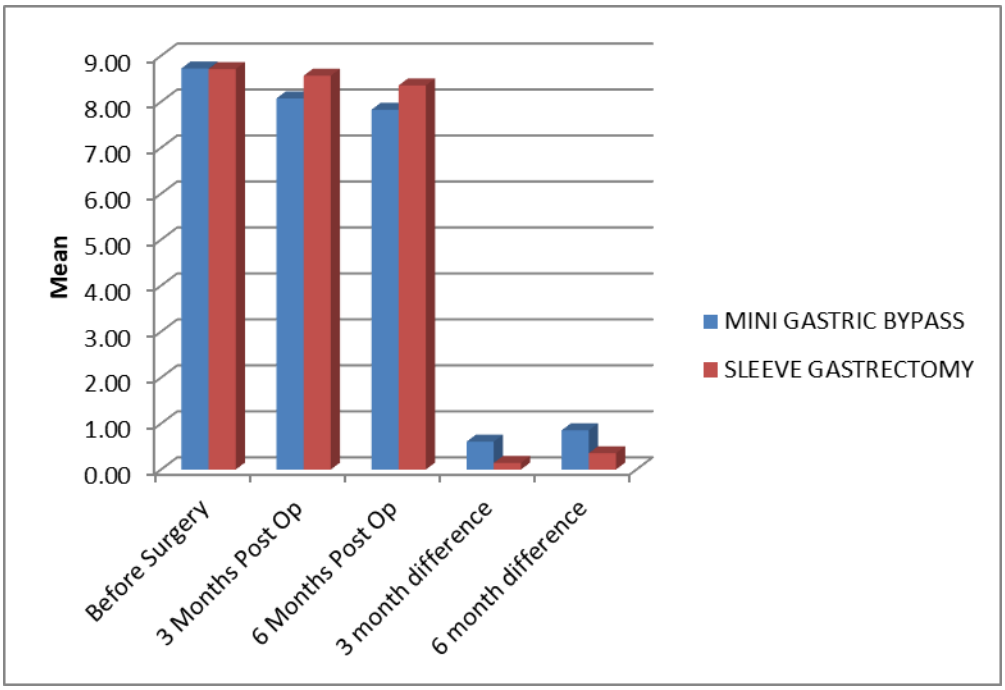

FIGURE 12: COMPARISON OF PRE & POST OPERATIVE CALCIUM LEVELS BETWEEN TWO SURGERY GROUPS

DISCUSSION

The present prospective study was conducted in the Department of General Surgery of The Dayanand Medical College & Hospital, Ludhiana. The study was done to determine and compare the preoperative and postoperative nutritional status between two types of Bariatric Surgeries i.e Mini gastric bypass and Sleeve gastrectomy. A total of 25 patients who were fulfilling the criteria of Bariatric surgery were enrolled for the study. A written informed consent was taken from every patient. The study was approved by institutional ethical committee.

The increasing prevalence of obesity and comorbid conditions worldwide prompts for effective strategies for both treatment and prevention.[44] The treatment of obesity includes lifestyle changes (dietary restrictions and increased physical activity), the use of medications, and in some cases, surgery. Drug treatment in general leads to a 5%-15% weight loss and should be considered only as an adjunct to lifestyle changes. Unfortunately, with respect to lifestyle intervention, medical treatment rarely yields satisfactory results in the long term.[45] Bariatric surgery has proven to achieve greater weight loss than non-surgical management and, most importantly, has proven to maintain it in the long term. Thus, in patients with morbid obesity, *i.e*., a body mass index of ≥ 40 or ≥ 35 kg/m^2 with co-morbidities, bariatric surgery is presently considered to be the only effective therapy for obesity.[46,47]

Among the possible complications, nutritional deficiencies deserve careful consideration. They can develop as a consequence of reduced intake and/or malabsorption of nutrients and are more commonly seen after malabsorptive or mixed procedures in comparison to the restrictive procedures. Nutritional deficiencies can present with a wide range of clinical manifestations, depending on the specific nutrients/micronutrients that are involved, the severity, and the duration of the deficiency states.

Thus a nutritional screening both before and after surgery is strongly recommended.[34]

With more than 45,000 procedures in France in 2014, bariatric surgery has gained in popularity for treatment of morbid obesity in USA and all around the world.[48] Despite laparoscopic gastric bypass (LRYGB) was found as the gold standard procedure at the beginning of the 21st century, laparoscopic sleeve gastrectomy (LSG) and laparoscopic mini gastric bypass (LMGB) are procedures challenging LRYGB since few years.[49,50]

Thus, the present study was planned to assess and compare the preoperative and postoperative nutritional status between two types of bariatric surgical interventions i.e Mini gastric bypass and Sleeve gastrectomy.

In our study, maximum number of patients 11(44%) were in age group more than 60, while 10(40%) belonged to age group below 40years and 4(16%) to the age group 41-50years.Similar results were observed in a study by **Praveenraj P et al.**[51] **and Kansou G et al.**[52] Most of patients enrolled in study were females. Similar results were observed in studies by **Praveenraj P et al.**[51] **and Kansou G et al,**[52] with females undergoing bariatric surgical interventions almost twice than males.

In our study, patients subjected to surgery with either techniques were suffering with co-morbidities like diabetes, hypertension etc. **Ramirez et al.[53]** had shown bariatric surgeries can be safely performed even in patients >70 years of age with a low rate of complications and acceptable improvement of co-morbidities. The most common co-morbidity observed in our study was diabetes mellitus. Similar results were observed by **Guan B et al.**[54]

In our study, BMI before surgery, after 3mths and 6mths was observed to be 48.1, 40.0 and 36.3. Similar results were seen in study by **Kansou G et al,**[52] that showed BMI values for both groups 43.4 ± 6.5 *vs* 42.8 ± 5.0.

Weight loss was observed to be more after mini gastric bypass than sleeve gastrectomy group, with an insignificant relation. Results of our study were in accordance with studies by **Kansou G et al,**[52] **and Kular KS et al.**[55] which observed that LMGB to be more effective for long term weight loss than LSG.

We observed that various nutrient levels like Ferritin, calcium, iron, albumin, protein, Vit B12 etc. Total protein levels during mini gastric bypass from 7.32 ng/mL to 6.91 ng/mL& 6.38 ng/mL at 3 months and 6 months while mean fall in total protein during sleeve gastrectomy from 7.39 ng/mL to 7.23 ng/mL& 7.11 ng/mL at 3 months and 6 months with a significant difference. Protein loss was found to be more in patients treated with mini gastric bypass technique than with sleeve gastrectomy. Similar results were observed by **Motamedi MAK et al.**[56], in their study. They found that patient who underwent MGB surgery developed malnutrition in the first postoperative year.**Heber D et al.**[57], stated that protein malnutrition is generally attributed to the acquired food intolerance for protein-rich foods.

Protein deficiency (serum albumin <3.5 mg/dL) remains the most severe macronutrient complication associated with malabsorptive surgical procedures, usually occurring in the first months after malabsorptive procedures, and is generally attributed to the acquired food intolerance for protein-rich foods.[57] In our study, total albumin levels after mini gastric bypass and sleeve gastrectomy was 3.67±0.33 g/dL and 4.18±0.47 g/dL respectively at 3 months post operative and 3.52±0.13 g/dL and 3.97±0.16 g/dL respectively at 6 months post operative with a significant difference.

Albumin loss was more evident in patients treated with mini gastric bypass technique than with sleeve gastrectomy. Hypoalbuminemia is an important complication after sleeve gastrectomy and Mini Gastric Bypass (MGB) and is more frequent in vegetarians, diabetic nephropathy, and alcoholic and liver disease patients. Similar to our study, **Kermansaravi M et al.**[58], advocated that the patients must be followed in regular intervals and

serum albumin must be checked in every visit after MGB. **Kermansaravi M et al.**[58] reported a case of death of patient who suffered with severe Hypoalbuminemia after MGB. **According to Taylor R et al.**[59], the possible mechanism can be portal pressure increasing which lead to reduction of small bowel absorptive capacity and progression to malnutrition and hypoalbuminemia.

Among the iron ion availability markers, serum ferritin is one of the most used markers. We observed that Ferritin levels after mini gastric bypass and sleeve gastrectomy was 34.73±20.30 and 50.86±23.78 respectively at 3 months post operative; and 28.69±17.59 and 49.37±22.67 respectively at 6 months post operative, which was having a significant different. Ferritin levels were low in MGB than sleeve gastrectomy. Results of our study were in accordance with results of study by **Foratori GA Junior et al.**[60], Iron deficiency may occur due to anatomic changes after surgery, a low tolerance for red meat, reduced acidity in the stomach, the chronic use of drugs to suppress the secretion of gastric acid, and (in women) the loss of iron through menstruation.[60] **Richardson WS et al.**[61,62], observed that iron deficiency also occurs because primary absorption sites (duodenum and proximal jejunum) may be bypassed. The intake of foods high in iron is decreased because consumption of red meat is poorly tolerated by some patients. Absorption of iron is decreased because less gastric acid is available.

Folic acid deficiency is a potential complication of bariatric procedures that can contribute to anemia. The prevalence of this deficit after both restrictive and malabsorptive procedures ranges from 9% to 39%.[63] We observed that total folic acid levels got decreased in both the surgical interventions post-operatively, with a significant difference at 6mths. In MGB levels of folic acid were reduced more than sleeve gastrectomy. Similar results were observed by **Kominiarek MA.**[64]

Vitamin B12 deficiency is a major cause of anemia in patients who undergo bariatric surgery, with a prevalence of 19%-35% after 5 years.[65] In our study, we observed that Vitamin B12 levels after mini gastric bypass and sleeve gastrectomy was 241.71±142.29 pg/mL and 261.56±70.10 pg/mL respectively at 3 months post operative; and 216.65±130.32 pg/mLand 242.72±76.22 pg/mL respectively at 6 months post operative, which was having a significant different. B12 levels were decreased to more extent in case of patients operated with MGB than with sleeve gastrectomy. Similar results were obtained in study by **Muhuri D et al.**[66] **and Kwon Y et al.**[67]

Calcium and vitamin D deficiencies are the main factors that are responsible for the accelerated bone loss after bariatric surgery. The incidence of calcium deficiency after surgery is almost 10%[68] and is caused by reduced calcium absorption that results from bypassing the duodenum and proximal jejunum, which are the main sites of absorption. In some cases, calcium deficiency could be exacerbated by low calcium intake due to the intolerance/exclusion of milk products. The present study revealed that Mean calcium during mini gastric bypass from 8.73mg/dL at surgery to 8.07mg/dL& 7.83mg/dL at 3 months and 6 months while mean calcium during sleeve gastrectomy from 8.71mg/dL at surgery to 8.57mg/dL&8.36mg/dL at 3 months and 6 months. Calcium levels decreased with time and decrease was more evident in cases treated with MGB than sleeve gastrectomy. Similar to our study, Shah M et al.[68], found that hypocalcemia was identified in 3.6% of patients undergoing all bariatric surgery.

Thus our study showed that various nutritional deficiencies were reported after bariatric surgeries, with incidence of deficiencies being more evident with MGB than sleeve gastrectomy. Results were in accordance to various previous studies, which compared different kinds of bariatric surgeries.[69-72] Thus, malnutrition and micronutrient deficit after LMGB is a

major concern because of malabsorptive component of LMGB (bilio-pancreatic diversion).

Nutrition is the most important aspect of follow-up to safely maximize weight loss and prevent weight gain. The main goals after any bariatric gastric surgery are threefold: (1) to maximize weight loss and absorption of nutrients, (2) to maintain adequate hydration, and (3) to avoid vomiting and dumping syndrome. To assess proper nutrition, patients need to be asked to bring a 24-hour recall of dietary intake to their appointment. They should be advised to consume at least 64 oz of fluids daily, while avoiding sugary beverages and alcohol.[73]

Diet after gastric surgery may be inadequate because of the limiting size of the stomach pouch, which results in the patient eating smaller amounts of food. Protein intake is often a problem and is likely less than the 1.5 g/kg of ideal body weight. Most patients are able to consume 0.8–1 g of protein/kg of ideal body weight from a combination of foods and liquid supplements, which ends up being about 60–80 g of protein daily.[73]

Much of the nutritionist's work is related to informing patients how to eat properly and how to judge fluid, protein, carbohydrate, and fat intake. The importance of self-monitoring by means of keeping daily food records is emphasized from the initial visit.

The protein intake requirement after surgery is 60–80 g/d or 1.1–1.5 g/kg of ideal body weight (i.e., BMI = 25).[74] To achieve these recommendations, protein-rich foods (e.g., dairy products, eggs, fish, lean meat, soy products, and legumes) should be preferred over foods rich in carbohydrates or fats. The quality of the protein source is also very important, particularly with respect to the quantity of leucine, which helps maintain lean tissue.[75] The leucine content of foods varies markedly, but some foods are naturally high in leucine, including soy products, eggs, meat, lentils, and hard cheese.[76] If a protein supplement is indicated, whey protein is probably the best choice for increasing leucine consumption.

To avoid B12 deficiency, routine vitamin B-12 supplements to prevent deficits are required after GB surgery. Calcium deficiencies can be countered with calcium supplements. Calcium citrate supplements are preferable over calcium carbonate due to their absorption, which is independent of stomach acidity. Minimal daily nutritional supplementation post–bariatric surgery, according to the procedure, should include 1–2 adult multivitamin-plus-mineral supplements, 1200–2400 mg elemental calcium, ≥3000 IU vitamin D (titrated to therapeutic amounts), and 250–350 µg vitamin B-12/d or 1000 µg vitamin B-12/wk.[77]

Overall, the high prevalence of pre-surgery nutritional deficiencies in bariatric candidates supports the need for a careful pre-operative evaluation of the nutritional status, to assess and adequately correct the pre-existing deficits.

Nutritional deficiencies represent a relevant long-term clinical problem in patients who underwent bariatric surgery as a result of modifications to the gastrointestinal anatomy and physiology, which could impact macro- and micro-nutrient absorption. Therefore, the best practices guidelines highly recommend regular metabolic and nutritional monitoring after bariatric surgery, which frequency varies according to the type of procedure. In light of the high prevalence of nutrient deficiencies even prior to surgery, the current Guidelines also underscore the need for a complete pre-surgery nutritional assessment in all candidates for bariatric surgery.

Although there are few studies with long-term nutritional follow-up, there is general agreement that nutritional assessments should be performed throughout life; furthermore, multivitamin and calcium supplementation with added vitamin D is recommended for all weight-loss surgery patients.

In conclusion, nutritional surveillance is an essential component of the management of bariatric patients for the following reasons: (1) increases the patients' adherence to healthy dietary habits and appropriate supplementation regimens; (2) prevents the risk of weight regain; (3) facilitates the detection of possible nutritional deficiencies that could

develop despite medical therapy; and (4) contributes to maintaining a good quality of life.

Limitations of study:

1. The present study was conducted with limited sample size. Thus future studies are required to be conducted on more number of patients.
2. The present study was conducted on comparing only two surgical techniques. Thus we recommend widening the scope of study, by assessing various surgical techniques.
3. Future studies should be conducted to analyse various other nutrient deficiencies after weight loss surgeries.
4. Future studies should be conducted to evaluate the effect of nutritional supplementation given to compensate nutritional deficiencies after surgical interventions.
5. We did the study over a short period of time i.e 6 months. long term studies are needed to have an exact outcome of nutritional aspect of bariatric surgery i.e 2-5 years

SUMMARY AND CONCLUSION

The present prospective study was conducted in the Department of General Surgery of The Dayanand Medical College & Hospital, Ludhiana. The study was done to determine and compare the preoperative and postoperative nutritional status between two types of Bariatric Surgeries i.e Mini gastric bypass and Sleeve gastrectomy. A total of 25 patients who were fulfilling the criteria of Bariatric surgery were enrolled for the study. A written informed consent was taken from every patient. The study was approved by institutional ethical committee.

Various findings were observed in our study:

1. Weight loss was observed to be more after mini gastric bypass than sleeve gastrectomy group.
2. Total protein levels reduced during the both the procedures at 3 months and 6 months but it was more in mini gastric bypass technique than with sleeve gastrectomy.
3. Albumin loss was more evident in patients treated with mini gastric bypass technique than with sleeve gastrectomy.
4. We observed that Ferritin levels after mini gastric bypass and sleeve gastrectomy decreased post operatively, with a significant difference. Ferritin levels were low in MGB than sleeve gastrectomy.
5. We observed that total folic acid and vitamin B12 levels got decreased in both the surgical interventions post-operatively, with a significant difference at 6mths. In MGB levels of folic acid were reduced more than sleeve gastrectomy.
6. Calcium levels decreased with time and decrease was more evident in cases treated with MGB than sleeve gastrectomy.

Thus our study showed that various nutritional deficiencies were reported after bariatric surgeries, with incidence of deficiencies being more evident with MGB than sleeve gastrectomy.Therefore, the best practices guidelines highly recommend regular metabolic and nutritional monitoring

after bariatric surgery, which frequently varies according to the type of procedure. Thus, nutritional surveillance and supplementation is an essential component of the management of bariatric patients.

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S.No	Name	Age	Sex	CR No	OPD/WARD	DOA	DOD	History of present illness	Medical treatment for obesity	Any other therapy for obesity		Other comorbidities						
										Diet therapy duration (Kcal/day)	Physical Therapy	Hypertension	CAD	History of DM	Occupation	BP	Temp	SpO2 (on room air)
1	JK	45 YRS	FEMALE	617701	WARD	29 Dec 19	1 Jan 19	MORBID OBESITY	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	140/80	98.4	97
2	RK	32 YRS	FEMALE	635050	WARD	1/1/2019	4/1/2019	MORBID OBESITY	NO	YES	NO	NO	NO	NO	GOVT EMPLOYEE	120/70	98.4	96
3	KK	36 YRS	FEMALE	648305	WARD	4/1/2019	8/1/2019	MORBID OBESITY	NO	NO	NO	YES	NO	NO	HOUSEKEEPER	140/80	98.4	96
4	JK	33 YRS	FEMALE	624071	WARD	21/1/2019	24/1/2019	MORBID OBESITY	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	130/76	98.4	95
5	RB	62 YRS	FEMALE	681995	WARD	6/3/2019	9/3/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	YES	NO	YES	HOUSEKEEPER	150/80	98.4	96
6	JK	60 YRS	FEMALE	913142	WARD	9/3/2020	12/3/2020	MORBID OBESITY	NO	NO	NO	NO	NO	YES	HOUSEKEEPER	112/60	98.6	96
7	AR	52 YRS	FEMALE	704663	WARD	8/4/2019	11/4/2020	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	130/80	98.4	96
8	VA	26 YRS	FEMALE	732278	WARD	20/5/2019	23/5/2020	MORBID OBESITY WITH BREATHLESSNESS	NO	YES	NO	NO	NO	NO	GOVT EMPLOYEE	130/76	98.4	97
9	B	51 YRS	FEMALE	351293	WARD	24/5/2019	31/5/2019	MORBID OBESITY	NO	NO	NO	NO	NO	YES	HOUSEKEEPER	128/60	98.6	96
10	OP	74 YRS	MALE	36331	WARD	10/6/2019	13/6/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	YES	NO	RTD.	130/74	97.6	98
11	SS	38 YRS	MALE	743901	WARD	14/6/2019	17/6/2019	MORBID OBESITY	NO	YES	NO	NO	NO	NO	GOVT EMPLOYEE	130/80	98.4	97
12	NK	45 YRS	FEMALE	752727	WARD	21/6/2019	25/6/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	130/80	98.4	95
13	HK	54 YRS	FEMALE	760282	WARD	3/7/2019	7/7/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	NO	YES	HOUSEKEEPER	130/80	98.4	96
14	JS	35 YRS	MALE	719448	WARD	8/7/2019	12/7/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	YES	NO	NO	NO	NO	BUSINESSMAN	130/80	98.4	96
15	SS	43 YRS	MALE	759333	WARD	11/7/2019	14/7/2019	MORBID OBESITY	NO	NO	NO	NO	NO	NO	BUSINESSMAN	130/80	98.4	96

S.No	Name	Age	Sex	CR No	OPD/WARD	DOA	DOD	History of present illness	Medical treatment for obesity	Any other therapy for obesity		Other comorbidities						
										Diet therapy duration (Kcal/day)	Physical Therapy	Hypertension	CAD	History of DM	Occupation	BP	Temp	SpO2 (on room air)
16	HS	44 YRS	FEMALE	182910	WARD	2/9/2019	4/9/2019	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	130/80	97.6	96
17	JP	58 YRS	MALE	812053	WARD	17/9/2019	20/9/2019	MORBID OBESITY	NO	NO	NO	NO	NO	YES	BUSINESSMAN	130/80	98.4	97
18	AG	31 YRS	MALE	505192	WARD	18/9/2019	21/9/2019	MORBID OBESITY	NO	NO	NO	NO	NO	YES	BUSINESSMAN	130/80	98.4	98
19	NQ	40 YRS	FEMALE	851443	WARD	18/11/2019	22/11/2019	MORBID OBESITY	NO	NO	NO	YES	NO	NO	GOVT EMPLOYEE	130/80	98.4	96
20	RG	51 YRS	FEMALE	852433	WARD	19/11/2019	22/11/2019	MORBID OBESITY	NO	NO	NO	YES	NO	YES	HOUSEKEEPER	130/80	98.4	97
21	GS	39 YRS	MALE	867708	WARD	16/12/2019	19/12/2019	MORBID OBESITY	NO	NO	NO	NO	NO	YES	BUSINESSMAN	130/80	98.4	97
22	AA	34 YRS	FEMALE	651112	WARD	19/2/2020	21/2/2020	MORBID OBESITY	NO	NO	NO	NO	NO	NO	HOUSEKEEPER	110/60	97.6	95
23	IK	51 YRS	FEMALE	900644	WARD	17/2/2020	24/2/2020	MORBID OBESITY WITH BREATHLESSNESS	NO	NO	NO	NO	NO	YES	HOUSEKEEPER	120/90	98.2	96
24	KK	57 YRS	FEMALE	679675	WARD	13/2/2020	17/2/2020	MORBID OBESITY	NO	NO	NO	YES	NO	NO	HOUSEKEEPER	130/80	98.2	96
25	AK	53 YRS	FEMALE	927968	WARD	28/5/2020	1/6/2020	MORBID OBESITY	NO	NO	NO	NO	NO	YES	HOUSEKEEPER	122/64	98.4	95

S.No	Name	Age	General Physical examination									Investigations
			PR	RR	Pallor	Cyanosis	Lymphadenopathy	Clubbing	Edema	Icterus	Petechie/ Purpura	
1	JK	45 YRS	80	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%,USG ABDOMEN-FATTY LIVER GRADE II
2	RK	32 YRS	78	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE I
3	KK	36 YRS	108	16	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE III
4	JK	33 YRS	86	20	NO	NO	NO	NO	NO	NO	NO	PFT-FVC-76%; FEV1-59%; FEV1/FVC-82%;VC-76%; USG ABDOMEN-HEPATOMEGALY WITH FATTY LIVER GRADE II
5	RB	62 YRS	82	18	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60% ; PFT- FEV1-89%;VC-91% ; USG ABDOMEN-FATTY LIVER GRADE II
6	JK	60 YRS	94	22	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60% ; USG ABDOMEN-FATTY LIVER GRADE I
7	AR	52 YRS	96	18	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE I
8	VA	26 YRS	82	18	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE II
9	B	51 YRS	88	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60% ; USG ABDOMEN-FATTY LIVER GRADE I
10	OP	74 YRS	84	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-CAD/RWMA/SEVERE LV SYSTOLIC DYSFUNCTION; EF-28%; MILD MR; MILD TR WITH PASP-40mmHg; LV DIASTOLIC DYFUNCTION (TYPE-III); USG ABDOMEN-FATTY LIVER GRADEIII
11	SS	38 YRS	82	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60% ; PFT-FVC-71%; FEV1-68%; FEV1/FVC-99%;VC-65% MILD RESTRICTION; USG ABDOMEN-HEPATOMEGALY WITH FATTY LIVER GRADE III
12	NK	45 YRS	96	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE III
13	HK	54 YRS	82	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%; USG ABDOMEN-FATTY LIVER GRADE II
14	JS	35 YRS	84	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GARDE III
15	SS	43 YRS	82	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-POST DVR-PROSTHETIC (METALLIC) MITRAL & AAORTIC VALVE NORMAL FUNCTION; NORMAL LV SYSTOLIC FUNCTION;EF-60%;LA DILATED; NO CLOT ; PFT-FVC-61%; FEV1-49%; FEV1/FVC-83%; SEVERE OBSTRUCTION; USG ABDOMEN-HEPATOMEGALY WITH FATTY LIVER GRADE III

S.No	Name	Age	General Physical examination									Investigations
			PR	RR	Pallor	Cyanosis	Lymphadenopathy	Clubbing	Edema	Icterus	Petechie/ Purpura	
16	HS	44 YRS	96	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%;USG ABDOMEN-FATTY LIVER GRADE II
17	JP	58 YRS	82	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-FATTY LIVER GRADE II
18	AG	31 YRS	84	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-HEPATOMEGALY WITH FATTY LIVER GRADE II
19	NQ	40 YRS	88	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%;USG ABDOMEN-FATTY LIVER GRADE II
20	RG	51 YRS	96	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%; USG ABDOMEN-FATTY LIVER GRADE III
21	GS	39 YRS	82	20	NO	NO	NO	NO	NO	NO	NO	USG ABDOMEN-HEPATOMEGALY WITH FATTY LIVER GRADE II/III
22	AA	34 YRS	104	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%;USG ABDOMEN-FATTY LIVER GRADE III
23	IK	51 YRS	82	24	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%;USG ABDOMEN-FATTY LIVER GRADE I
24	KK	57 YRS	88	20	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60%;USG ABDOMEN-FATTY LIVER GRADE II
25	AK	53 YRS	92	22	NO	NO	NO	NO	NO	NO	NO	2D-ECHO-NORMAL LV SIZE & SYSTOLIC FUNCTION; LVEF-60% ; USG ABDOMEN-FATTY LIVER GRADE II/III

S.No	Name	Age	Surgery performed	PARAMETERS															
				Weight			Height			BMI			Triceps skin fold thickness			Total Protein			
				Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery
1	JK	45 YRS	MINI GASTRIC BYPASS	102	90	78	1.5	1.5	1.5	45.3	40	34.7	41	35	33	8	7.3	6	4.7
2	RK	32 YRS	SLEEVE GASTRECTOMY	100	89.6	81	1.6	1.6	1.6	37.2	35	31.6	37	35	33	8.2	7.4	7.3	4.7
3	KK	36 YRS	SLEEVE GASTRECTOMY	113	94	88	1.5	1.5	1.5	50.2	41.8	39.1	42	38	36	7.5	7.3	7.1	4.1
4	JK	33 YRS	MINI GASTRIC BYPASS	170	140	122	1.7	1.7	1.7	58.8	48.4	42.2	45	41	35	7.1	6.3	6	4.7
5	RB	62 YRS	MINI GASTRIC BYPASS	96	85	78	1.57	1.57	1.57	38.9	34.5	31.6	39	37	31	8	7.4	6.2	4.2
6	JK	60 YRS	MINI GASTRIC BYPASS	114	98	94	1.6	1.6	1.6	44.5	38.3	36.7	41	37	31	8.2	8	7.3	3.39
7	AR	52 YRS	MINI GASTRIC BYPASS	98	84	76	1.58	1.58	1.58	39.3	33.6	30.4	37	33	27	6.7	6.7	6.1	3.94
8	VA	26 YRS	MINI GASTRIC BYPASS	92	84	80	1.6	1.6	1.6	35.9	32.8	31.3	34	31	26	7.3	7.2	6.4	4.15
9	B	51 YRS	MINI GASTRIC BYPASS	135	96	86	1.6	1.6	1.6	52.7	39	35	37	34	30	6.9	6.9	6.3	2.45
10	OP	74 YRS	SLEEVE GASTRECTOMY	108	92	82	1.57	1.57	1.57	45.4	37.3	33.3	40	36	34	7.2	7.4	6.9	4.46
11	SS	38 YRS	MINI GASTRIC BYPASS	172	130	100	1.46	1.46	1.46	78.7	61	46.9	49	44	37	7.1	6.9	6.6	3.89
12	NK	45 YRS	MINI GASTRIC BYPASS	94	81	78	1.5	1.5	1.5	41.8	35.6	34.7	36	31	30	7.5	7.2	6.2	4.06
13	HK	54 YRS	MINI GASTRIC BYPASS	100	80	75	1.57	1.57	1.57	40.6	35.6	33.3	35	32	31	7.1	6.4	6.6	5
14	JS	35 YRS	SLEEVE GASTRECTOMY	120	90	85	1.5	1.5	1.5	53.3	40	37.8	46	42	39	6.7	7	6.8	4.5
15	SS	43 YRS	MINI GASTRIC BYPASS	96	82	78	1.56	1.56	1.56	39.4	35.6	34.7	33	31	25	7.3	7.1	6.9	4.16

S.No	Name	Age	Surgery performed	PARAMETERS															
				Weight			Height			BMI			Triceps skin fold thickness			Total Protein			
				Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery
16	HS	44 YRS	SLEEVE GASTRECTOMY	107	93	89	1.5	1.5	1.5	47.6	41.3	39.6	38	35	32	7	7.2	7	3.5
17	JP	58 YRS	SLEEVE GASTRECTOMY	123	105	99	1.5	1.5	1.5	54.7	46.7	44	43	37	36	7.6	7.4	7.3	3.8
18	AG	31 YRS	MINI GASTRIC BYPASS	135	98	89	1.6	1.6	1.6	52.7	38.3	34.8	40	37	31	7.5	6.7	6.4	4.17
19	NQ	40 YRS	MINI GASTRIC BYPASS	102	91	85	1.6	1.6	1.6	39.8	35.5	31.6	34	31	26	6.8	6.3	5.5	3.85
20	RG	51 YRS	SLEEVE GASTRECTOMY	126.4	100	90	1.59	1.59	1.59	49.8	39.6	35.6	35	32	31	7.6	7.5	7.6	4.04
21	GS	39 YRS	SLEEVE GASTRECTOMY	120	100	95	1.5	1.5	1.5	53.3	39.6	37.6	41	36	35	7.2	6.6	6.5	4.46
22	AA	34 YRS	MINI GASTRIC BYPASS	119	100	92	1.46	1.46	1.46	55.8	46.9	43.2	43	37	32	7.4	7	6.6	3.91
23	IK	51 YRS	SLEEVE GASTRECTOMY	120	101	81	1.5	1.5	1.5	53.3	44.9	36	41	37	36	7.5	7.3	7.5	3.8
24	KK	57 YRS	MINI GASTRIC BYPASS	127	100	90	1.6	1.6	1.6	49.6	39.1	35.8	39	35	29	7.9	7.1	6.8	3.8
25	AK	53 YRS	MINI GASTRIC BYPASS	115	100	89	1.62	1.62	1.62	43.8	38.1	33.9	36	32	27	6.3	6.1	6.1	3.6

S.No	Name	Age	Albumin		Ferritin			Folic Acid			Vitamin B12			Calcium		
			3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op
1	JK	45 YRS	3.8	3.6	34	28	21	4.5	4.3	3.7	230	190	181	9.1	8.2	8.5
2	RK	32 YRS	4.3	4.27	45.6	43	46.3	9	10.1	9.8	145.3	139	128	7.5	7.5	7.4
3	KK	36 YRS	4	3.9	46.6	45	42.8	9.2	9.3	8.6	198.1	189	131	8.9	8.7	8.6
4	JK	33 YRS	3.7	3.55	87	62	54	12.9	10	9.8	200	111	101	8.5	8.3	7.9
5	RB	62 YRS	3.6	3.5	35	31	28	12.1	7	7.1	722	657	607	8.8	8.1	8.1
6	JK	60 YRS	3.29	3.1	87	69	52.6	4.8	3.8	3.2	366.5	366	341	8	7.1	7.3
7	AR	52 YRS	3.7	3.4	21.6	20	14.6	6.46	6.02	6.01	302.4	271.5	245.6	8.2	8	7.8
8	VA	26 YRS	3.65	3.54	11.3	10	9.1	2.9	2.3	2	201	132.9	106.4	8.9	8.7	8.7
9	B	51 YRS	2.45	3	14	13	12	2.9	3	4	167.6	200	211	9.4	8	7.8
10	OP	74 YRS	4.32	4	32	33	31.4	6.3	6.1	7.1	222	221	209	8.6	8.4	8.3
11	SS	38 YRS	3.6	3.5	66	52	43.8	1.62	1.5	1.1	250	221	201.4	8.5	7.4	7.2
12	NK	45 YRS	3.67	3.56	37.6	33	21	14	10	10.5	200	127	112.4	8.5	8.7	8.1
13	HK	54 YRS	3.8	3.65	71.4	71	65	12	11.3	11.3	305	301.8	243	9.7	9.4	8.5
14	JS	35 YRS	5	4.1	10.9	10	9.8	20	18	19	236	229	211.5	8.7	8.7	8.4
15	SS	43 YRS	3.7	3.6	26.3	26	24	13.1	9	6.5	390	381	321.6	9.2	7.3	7.4

S.No	Name	Age	Albumin		Ferritin			Folic Acid			Vitamin B12			Calcium		
			3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op	Before Surgery	3 Months Post Op	6 Months Post Op
16	HS	44 YRS	3.94	3.8	86.6	85	76	11.5	10.6	9	371	345	327	9.2	9.1	8.4
17	JP	58 YRS	3.6	3.8	54	51.6	52	6.3	6.9	6.1	332.5	321	307	9	8.7	8.5
18	AG	31 YRS	3.7	3.55	17	12.5	12	15	12	11.8	200	167.5	174	9.2	8.3	8.3
19	NQ	40 YRS	3.76	3.57	31	26.4	23.7	4.7	4.4	4.4	198.5	143	123.7	8.4	8.1	7.6
20	RG	51 YRS	4.3	4.02	64.6	62.1	60	9.6	9.6	9.5	321	317	301	8.6	8.3	8.2
21	GS	39 YRS	4.23	4	43	44	41	12.1	10.6	11	287	284	269	9.1	9.1	8.9
22	AA	34 YRS	3.67	3.58	33	26	17	6.4	6.1	6.1	210	154	152	8.1	7.5	7.4
23	IK	51 YRS	3.94	3.8	87	84	85	4.2	4.9	3.9	331	309	301	8.8	8.6	8.5
24	KK	57 YRS	3.66	3.57	51	43	35	11	8.3	8.1	230	191	154.8	8.4	8.1	7.3
25	AK	53 YRS	3.76	3.5	10.5	11	9.5	8	7.2	7.1	240	211	184.9	8.7	7.9	7.3

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Date 11/6/19

The Principal,
DMC, Ludhiana.

Subject: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.05.2019 has approved the plan of thesis of **Parvartandeep Singh**, a student of your college for **MS General Surgery** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis

A comparative study of nutritional status between mini gastric bypass and sleeve gastrectomy

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The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

S P Singh

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

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A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF SURGERY

In

GENERAL SURGERY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES
FARIDKOT

NOVEMBER, 2018

DR. PARVARTANDEEP SINGH

DEPARTMENT OF GENERAL SURGERY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY
For the degree of	M.S. (GENERAL SURGERY)
Name of the candidate	Dr. Parvartandeep Singh
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Co-supervisor	Dr Navjot Bajwa, Professor and Head, Department of Biochemistry, DMCH. Dr Ashish Ahuja, Associate professor, Department of Surgery, DMCH.
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

INTRODUCTION: Obesity is a major worldwide problem in public health. Bariatric procedures have been shown to be more effective in the management of morbid obesity as compared to medical treatments in term of weight loss and sustainability. The two most commonly performed procedures are sleeve gastrectomy and gastric mini bypass. It has been shown that not only it causes rapid weight loss but also has effect on nutritional status of patient. Nutritional parameters include macronutrients like total protein, albumin and micronutrients such as serum ferritin, folic acid, vitamin b 12.

AIMS AND OBJECTIVES OF THE STUDY: To assess and compare preoperative and postoperative nutritional status between mini gastric bypass and sleeve gastrectomy

MATERIALS AND METHODS: This prospective study will be conducted At Dayanand Medical College and Hospital, Ludhiana for patients undergoing bariatric surgery from 1st November 2018 to 31st March 2020. The patients will be examined before surgery and postoperatively at 0,3,6 months using standard protocol.

CLINICAL SIGNIFICANCE: In this study, we will do long term follow up that include periodical nutritional assessment and multivitamins supplements has been prescribed systematically after surgery.

KEYWORDS: Sleeve Gastrectomy, Mini Gastric Bypass, Morbid Obesity, Nutritional deficiency.

(Signature)	(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY"** exist in the Department of General Surgery, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate himself/herself under our supervision and guidance.

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APPROVAL PROFORMA
BY
RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

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Department	General Surgery
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2. HOD Surgery	2. HOD Pathology
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4. HOD Medicine	4. HOD SPM
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Research Committee

Approved: Yes / ~~No~~

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Ethics Committee

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Ethics Committee

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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3	COURSE OF STUDY AND SUBJECT	M.S. GENERAL SURGERY
4	DATE OF ADMISSION OF COURSE	10th MAY 2018
5	TITLE OF THE TOPIC	A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Obesity is a major worldwide problem in public health. According to the National Institutes of Health (NIH), "Risk for morbidity and mortality accompanying obesity" is proportional to the degree of overweight. One of the most recognized methods for determining health risk related to weight is to calculate the body mass index (BMI) of an individual Body mass index (BMI) is the parameter used for defining obesity, and is expressed in terms of Kg/m2. Subjects with BMI of more than 30 Kg/m2 are categorized under obesity. For health risk assessment, waist circumference in combination with BMI are used for parameters.[1]

One of the prevalent health issues affecting over 30 percent of the world's population todays is obesity. Obesity is typically defined quite simply as excess body weight for height, but this simple definition belies an etiologically complex phenotype primarily associated with excess adiposity, or body fatness, that can manifest metabolically and not just in terms of body size. Obesity greatly increases risk of chronic disease morbidity—namely disability, depression, type 2 diabetes, cardiovascular disease, certain cancers—and mortality.[2-4]

Treatment of obesity includes both surgical and non-surgical interventions, as recommended by NIH. The nonsurgical approaches include low- and very low- calorie diets, behavioral modification, exercise, and the use of pharmacological agents. These methods for weight loss are limited as they fail to create a long term reduction in weight. Recently, the population has trended toward the use of bariatric surgeries due to the higher rate of success

and long-term weight maintenance. Bariatric surgery (BS) is currently the most effective treatment modality for obesity and its associated metabolic complications. The main benefits of this intervention include prolonged weight loss, improvement of associated comorbidities, and quality of life.[3-5]

Most novel gastric surgeries are the min gastric bypass and sleeve gastrectomy. Many obese subjects have already-existing nutritional deficiencies before bariatric procedures. These deficiencies commonly include iron, Vitamin B12, thiamin, folate and Vitamin D. Screening and correction of micronutrient deficiencies preoperatively are crucial, as these deficiencies may be more exacerbated following bariatric procedures, leading to devastating conditions. While several studies have described nutrient status pre- and post-bariatric surgery, there is paucity in the Indian literature that investigates nutritional status pre-surgery and post-surgery in obese subjects.[6-8]

Prevention of vitamin and mineral deficiencies requires long-term patient's follow-up and understanding of the functions of these micronutrients in human body, in addition to the deficiency signs and symptoms. The long-term nutritional supplementation, although so stressed as an important conduct, still represents a hindrance to success in surgical treatment of obesity. The regular use of a nutritional supplementation has been advocated when appropriately done: at least five times a week. However, only 33% of patients comply with that recommendation, and 7.7% stop using the multivitamins/minerals two years after surgery.[9-11]

Hence; under the light of above mentioned data, the present study is planned to assess and compare preoperative and postoperative nutritional status between min gastric bypass and sleeve gastrectomy.

6.2 REVIEW OF LITERATURE

Bell NH et al. (1985) assessed 12 obese white individuals, five men and seven women, and 14 nonobese white subjects, eight men and six women, ranging in age from 20 to 35 yr. Body weight averaged 106 +/- 6 kg in the obese and 68 +/- 2 kg in the nonobese subjects (P less than 0.01). Each of them were hospitalized on a metabolic ward and were given a constant daily diet containing 400 mg of calcium and 900 mg of phosphorus. Whereas mean serum calcium, serum ionized calcium, and serum phosphorus were the same in the two groups, mean serum immunoreactive PTH (518 +/- 48 vs. 243 +/- 33 pg/ml, P less than 0.001), mean serum 1,25-dihydroxyvitamin D [1,25(OH)2D] (37 +/- 2 vs. 29 +/- 2, P less than 0.01), and mean serum Gla protein (33 +/- 2 vs. 24 +/- 2 ng/ml, P less than 0.02) were significantly higher, and mean serum 25-hydroxyvitamin D (25-OHD) (8 +/- 1 vs. 20 +/- 2 ng/ml, P less than 0.001) was significantly lower in the obese than in the nonobese men and women. Mean urinary phosphorus was the same in the two groups, whereas mean urinary calcium (115 +/- 10 vs. 166 +/- 13 mg/d, P less than 0.01) was significantly lower, and mean urinary cyclic AMP (3.18 +/- 0.43 vs. 1.84 +/- 0.25 nM/dl GF, P less than 0.01) and creatinine clearance (216 +/- 13 vs. 173 +/- 6 liter/d, P less than 0.01) were significantly higher in the obese than in the nonobese individuals. There was a significant positive correlation between percentage of ideal body weight and urinary cyclic AMP (r = 0.524, P less than 0.01) and between percentage of ideal body weight and serum immunoreactive PTH (r = 0.717, P less than 0.01) in the two groups. The results provided evidence that alteration of the vitamin D-endocrine system in obese subjects is characterized by secondary hyperparathyroidism which is

associated with enhanced renal tubular reabsorption of calcium and increased circulating 1,25(OH)2D. The reduction of serum 25-OHD in them is attributed to feedback inhibition of hepatic synthesis of the precursor by the increased serum 1,25(OH)2D.[12]

Facchini FS et al.(2000) defined the relation between resistance to insulin-mediated glucose disposal and plasma concentrations of lipid hydroperoxides and liposoluble antioxidant vitamins in healthy volunteers. Insulin-mediated glucose disposal was determined in 36 healthy, nondiabetic volunteers by measuring their steady-state plasma insulin (SSPI) and glucose (SSPG) concentrations in response to a 180-min constant infusion of octreotide, insulin, and glucose. In addition, fasting plasma concentrations of lipid hydroperoxides and liposoluble antioxidant vitamins were determined by using the FOX 2 assay and liquid chromatography. Statistically significant direct relations were observed between SSPG and mean arterial blood pressure (r = 0.44, P: = 0.008) and plasma lipid hydroperoxide concentrations (r = 0.42, P: = 0.01), whereas significant inverse correlations were found between SSPG and alpha-carotene (r = -0.58, P: = 0.0002), beta-carotene (r = -0.49, P: = 0.004), lutein (r = -0.35, P: = 0.04), alpha-tocopherol (r = -0. 36, P: = 0.04), and delta-tocopherol (r = -0.45, P: = 0.007).These findings suggest that total plasma lipid peroxidation is increased in insulin-resistant individuals at an early, preclinical stage, i.e., well before the development of glucose intolerance and type 2 diabetes.[13]

Flancbaum L et al (2006) retrospectively analyzed the preoperative values of serum albumin, calcium, 25-OH vitamin D, iron, ferritin, hemoglobin, vitamin B12, and thiamine in 379 consecutive patients (320 women and 59 men;

mean body mass index 51.8 +/- 10.6 kg/m2; 25.8% white, 28.4% African American, 45.8% Hispanic) undergoing bariatric surgery between 2002 and 2004. Preoperative deficiencies were noted for iron (43.9%), ferritin (8.4%), hemoglobin (22%; women 19.1%, men 40.7%), thiamine (29%), and 25-OH vitamin D (68.1%). Low ferritin levels were more prevalent in females (9.9% vs. 0%; P = 0.01); however, anemia was more prevalent in males (19.1% vs. 40.7%; P < 0.005). Patients younger than 25 years were more likely to be anemic than patients over 60 years (46% vs. 15%; P < 0.005). This correlated with iron deficiency, which was more prevalent in younger patients (79.2% vs. 41.7%; P < 0.005). Whites (78.8%) and African Americans (70.4%) had a higher prevalence of vitamin D deficiency than Hispanics (56.4%), P = 0.01. Whites were the least likely group to be thiamine deficient (6.8% vs 31.0% African Americans and 47.2% Hispanics; P < 0.005). Nutritional deficiencies are common in patients undergoing Roux-en-Y gastric bypass, and these deficiencies should be detected and corrected early to avoid postoperative complications.[14]

Toh SY, Zarshenas N, Jorgensen J (2009) determined the prevalence of nutrient deficiencies in patients who present for bariatric surgery, assess nutritional status after surgery, and compare these with preoperative levels. The screening included serum ferritin, vitamin D, vitamin B (12), homocysteine, folate, red blood cell folate, and hemoglobin. Results were available for 232 patients preoperatively and 149 patients postoperatively. Preoperatively, vitamin D deficiency was noted at 57%. The prevalence of abnormalities 1 year after roux-en-Y gastric bypass was higher compared with preoperative levels (P < .05). After surgery, anemia was detected in 17%,

elevated homocysteine levels (women only) in 29%, low ferritin in 15%, low vitamin B (12) in 11%, and low RBC folate in 12%. Mean hemoglobin, ferritin, and RBC folate levels deteriorated significantly but remained well within normal ranges. The prevalence of vitamin D deficiencies decreased, but not significantly. In sleeve gastrectomy patients, mean ferritin levels decreased ($P < .05$), without any patient developing a deficiency. Vitamin D deficiency is common among morbidly obese patients seeking bariatric surgery.[15]

Jastrzębska-Mierzyńska M et al. (2015) evaluated changes in nutritional status after surgical treatment of obesity in the early postoperative period. The study included 50 patients (30 women and 20 men) treated surgically due to morbid obesity. During the preliminary visit and during control visits measurements of body mass, height, and waist and hip circumference were conducted. Statistical analysis was conducted using the program Statistica.[10] Six months after the surgery, in the group of women, significant reduction of average body mass, average waist circumference, average hip circumference and average body mass index (BMI) was observed . A significant decrease in muscle mass was also noted. Both in women and in men, 6 months after the surgery, a significant decrease in fasting glucose concentration, fasting insulin and triglycerides in blood serum was observed. Bariatric procedures lead to significant body mass, BMI, waist and hip circumference reduction. Loss of body mass is caused mainly by the reduction of fat tissue.[16]

Aron-Wisnewsky J et al (2016) analyzed the effect of food restriction on nutritional parameters in the short-term (≤3 months) period after BS in morbid obesity. They followed 22 obese women who underwent Roux-en-Y gastric bypass (GBP) or adjustable gastric banding (AGB) at baseline (T0) and 1 (T1)

and 3 (T3) months after surgery. They evaluated food intake, nutrient adequacy and serum concentrations of vitamins and minerals known to be at risk for deficiency following BS. Serum analysis confirmed nutritional deficiencies for iron and thiamine for 27 and 23% of the patients, respectively. Serum analysis demonstrated a continuous decrease in prealbumin during the follow-up, indicating mild protein depletion in 21 and 57% of GBP patients and 50 and 63% of AGB patients, respectively, at T1 and T3. Regarding vitamins and minerals, systematic supplementation after GBP prevented most nutritional deficiencies. By contrast, AGB patients, for whom there is no systematic supplementation, developed such deficiencies. Their results suggested that cautious monitoring of protein intake after BS is mandatory.[17]

Al-Mutawa A et al. (2018) assessed and provided baseline data on the nutritional status of bariatric candidates. A retrospective study was conducted on obese patients who underwent bariatric surgery from 2008 to 2015. The medical records of 1538 patients were reviewed for this study. Pre-operatively, the most commonly observed vitamin deficiencies were Vitamin D (76%) and Vitamin B12 (16%). Anemia and iron status parameters were as follows: hemoglobin 20%, mean corpuscular volume (MCV) 48%, ferritin 28%, serum iron 51%, and transferrin saturation 60%. Albumin and transferrin were found to be low in 10% and 9% of the patients, respectively, prior to surgery. In addition to deficiencies, a great number of patients had hypervitaminosis pre-operatively. Excess levels of Vitamin B6 (24%) was the most remarkable. The findings in this study advocated a close monitoring and tailored supplementation pre- and post-bariatric surgery.[18]

6.3 AIMS AND OBJECTIVES OF THE STUDY

- To assess and compare preoperative and postoperative nutritional status between mini gastric bypass and sleeve gastrectomy.

7. MATERIALS AND METHODS

The present study is a time bound study and will be conducted in the department of general surgery of the Dayanand Medical College & hospital, Ludhiana.

Patients submitted for LSG and mini gastric bypass between 1st November 2018 and March 2020 will be included in the present study. Ethical approval will be obtained from the institutional ethical committee and written consent will be obtained from all the patients after explaining in detail the entire research protocol.

7.1 SOURCE OF DATA

Examinations will be conducted preoperatively at 0 and postoperatively at 3 and 6 months after surgery. Weight, height, BMI and Triceps skin fold thickness will be measured and fasting blood samples will be drawn at all visits

7.2 METHOD OF COLLECTION OF DATA

Clinical assessment including Weight, height, BMI and Triceps skin fold thickness will be taken into account along with haemotological assessment both preoperatively and postoperatively for Macronutrients (Protein, albumin) and micronutrients (Ferritin,Calcium, Folic acid and Vitamin B12) will be done. Post-operative assessment of the samples will be done at 3 months and 6 months.

INCLUSION CRITERIA:

- Participants with morbid obesity.
- Patients within age group of 18–60 years with BMI ≥ 40, or BMI ≥ 35 with co-morbidities.

EXCLUSION CRITERIA:

- Past history of any bariatric surgical intervention.
- Patients suffering from terminal illness including advanced stage cancer and end-stage renal, hepatic and cardiopulmonary disease.
- Patients who were unable to understand the nature of bariatric surgery or the behavioral changes required afterwards, including untreated schizophrenia, active substance abuse.
- Patients not consenting to participate in the study.
- Patients opting out of the study at any time during the study.

OPERATIVE TECHNIQUE

1. LAPAROSCOPIC SLEEVE GASTRECTOMY

After visual access to the intraperitoneal space using a 12 mm visi pod trocar 18 cm below the left hypochondrium, the abdomen will be insufflated to 15-20mmHg. Then two 12mm ports and two 5mm ports will be placed per abdomen, and a Nathanson liver retractor will be inserted through a 5mm skin Incision in the subxiphoid location to retract the left lateral segment of liver. Although there are minor variations of the LSG procedure, in general 75%-80% of the greater curvature is excised leaving a narrow stomach tube. A point on the greater curvature, on the antrum, is chosen as a starting point. This has previously been described as ranging from 2-10cm from the pylorus. The lesser sac is entered by opening the gastro colic ligament. The short gastric vessels and the greater curvature ligaments (gastro splenic and gastro colic) are then divided with ultrasonic dissection to the left crus. A 32 French bougie is then passed transorally into the pylorus. Placed against the lesser curvature. A laparoscopic stapler with a green cartage (4.8 mm closed staple

height) followed by white cartages is introduced and is fired consecutively along the length of the bougie until the angle of His is reached at this point, about 75%-80% of the stomach has been separated. The specimen is removed by enlarging one of the 12-mm ports. A drain is then placed alongside the staple line.

2. LAPAROSCOPIC MINI-GASTRIC BYPASS

The technique used for LMGBP was a 5-port technique similar to that described by Rutledge. A long gastric tube was created using an EndoGIAstapler approximately 1.5 cm to the left of the lesser curvature from the antrum to the angle of His. A loop gastroenterostomy was created with the small bowel about 200 cm distal to the ligament of Trietz with an Endo-GIA stapler. The gastroenterostomy was then closed with continuous suture. One hemovac drain was left in the lesser sac before closure of the wound.

DURATION OF THE STUDY: The study will be conducted from 1st November 2018 to 31st March 2020 time period on obese subjects who will undergo or have undergone Laparoscopic Mini Gastric Bypass and sleeve gastrectomy Surgery for Morbid Obesity. Patients will be followed up for 3 & 6 months from the date of surgery.

OUTCOME

The outcome of the study will be assessed from the following parameters:

1. Weight, height, BMI and Triceps skin fold thickness
2. Micronutrients (ferritin,Calcium, Folic acid and Vitamin B12)
3. Macronutrients (Total Protein, albumin)

STATISTICAL ANALYSIS

Data were described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups was done using Student t-test and Mann Whitney U test for independent samples for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test was performed and exact test was used when the expected frequency is less than 5. A probability value (p value)less than 0.05 was considered statistically significant. All statistical calculations were done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

Yes, patients included in the study will undergo haematological, biochemical investigations. For this, patients included in the study will be informed regarding their inclusion and written informed consent will be taken from all the patients included in the study. These are, however, essential for the patient management and are a part of the routine protocol for the management for patients undergoing laparoscopic mini gastric bypass and sleeve gastrectomy surgery.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Yes, attached herewith.

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PROFORMA

Date: S.No:

Name: OPD/WARD:

Age: Sex:

CR No.: DOA: DOD:

Address:

History of present illness:

Past history:

Medical treatment for obesity

Any other therapy for obesity

- Diet therapy duration(Kcal/day)
- Physical Therapy

Signature of Candidate Signature of Supervisor

Other comorbidities-

Hypertension

CAD

History of DM

Occupation:

General Physical examination:

BP-	**Temp-**	**SpO2 (on room air)-**
PR-	**RR-**	
Pallor-	**Cyanosis-**	**Lymphadenopathy-**
Clubbing-	**Edema-**	**Icterus-**

Petechie/Purpura-

Others:

Significant Systemic Examination:

Chest-

Per-Abdomen-

Signature of Candidate **Signature of Supervisor**

CVS

CNS

Investigations:

Surgery performed

PARAMETERS –

	Before Surgery	3 Months Post Op	6 Months Post Op
Weight			
Height			
BMI			
Triceps skin fold thickness			
Total Protein			
Albumin			
Ferritin			
Folic Acid			
Vitamin B12			
Calcium			

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o.....

.....am willing to participate in the study **"A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

.....
Signature of the Witness

Name:

.....
Signature of the patient

Signature of Candidate

Signature of Supervisor

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"A COMPARATIVE STUDY OF NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

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ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____

ਪਤਾ _____

_____
ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____

ਪਤਾ _____

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ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

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ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ